United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Texas Agricultural
Experiment Station

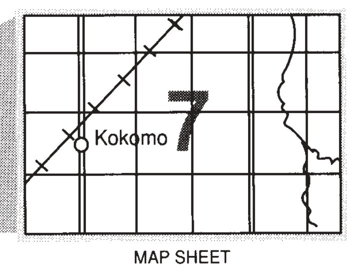
Soil Survey of Reagan and Upton Counties, Texas

How to Use This Soil Survey

General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

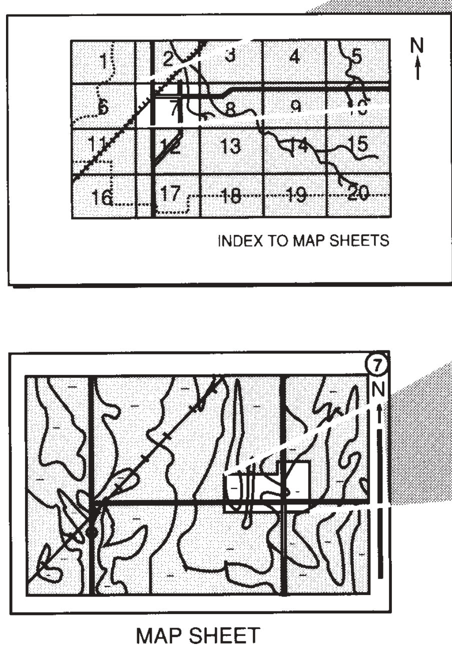


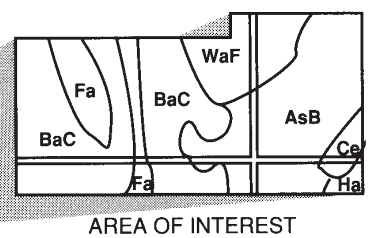
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map units symbols that are in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.





NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1989. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1989. This survey was made cooperatively by the Natural Resources Conservation Service and the Texas Agricultural Experiment Station. The survey is part of the technical assistance furnished to the Middle Concho Soil and Water Conservation District.

Cover: Santa Rita No. 1, site of the first major oil discovery in West Texas, is at Texon in Reagan County.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service homepage on the World Wide Web. The address is http://www.nrcs.usda.gov.

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Issued 2003

Foreword

This soil survey contains information that affects land use planning in this survey area. It contains predictions of soil behavior for selected land uses. The survey also highlights soil limitations, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations that affect various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

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Soil Survey of Reagan and Upton Counties, Texas

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United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with the Texas Agricultural Experiment Station

Reagan and Upton Counties are in the west-central part of Texas. This two-county area is 1,548,198 acres, or about 2,419 square miles (fig. 1).

Big Lake, the county seat of Reagan County, has a population of 3,404. Rankin, the county seat of Upton County, has a population of 1,216. McCamey, the only other town in Upton County, has a population of 2,436. The economy of the survey area is based on the petroleum industry, cattle and sheep ranching, and farming. About 37,000 acres in the area is irrigated cropland.

Large areas of deep or very deep, nearly level soils are productive rangeland or irrigated cropland. About 43 percent of the soils in the survey area is Reagan loam, 0 to 1 percent slopes; 14 percent is Reagan loam, 1 to 3 percent slopes; and 15 percent is the Conger-Reagan association, 0 to 3 percent slopes. The rest consist of 18 different soil series in 23 map units.

General Nature of the Survey Area

The history; physiography, relief, and drainage; natural resources; and climate are briefly described in this section.

History

In the 1860s, large herds of bison migrated to the survey area for the winter. Only small groups remained by the winter of 1876-77. Settlers interested in ranching began moving into the area about this time; they founded the town of Stiles in Reagan County and the town of Upland in Upton County. Although both towns were near the Butterfield Trail, later, when the railroad bypassed them, they became ghost towns.

The Butterfield Trail passed through the middle of both Reagan and Upton Counties *(4)*. The route is still visible in many places and is marked on the soil maps at the back of this publication. It was first used for wagons and cattle drives. From 1858 to 1861, it was used as a stage coach mail route from St. Louis to San Diego and San Francisco. Another stage coach route began at Fort Concho in Tom Green County, proceeded to Fort Grierson, and then on to Fort Stockton. This stage coach line operated from 1875 to 1882. The ruins of Fort Grierson and Grierson Spring are in the southwest part of Reagan County.

In May 1923, the discovery of oil at Texon was an event of major significance to West Texas. The well was Santa Rita No. 1, the first major oil discovery in the Permian Basin. Little farming took place in Reagan and Upton Counties before 1948; however, the northern part of the area had good quality underground water in sufficient amounts for light irrigation. Following World War II, many returning servicemen came to the area to farm. By 1958, 2,620 acres was irrigated by 40 wells in Reagan County, and 550 acres was irrigated by 9 wells in Upton County. The irrigated acreage and number of wells continued to increase. In 1984, in Reagan County, 25,000 acres was irrigated by 825 wells. In Upton County, 12,000 acres was irrigated by 460 wells.

Figure 1.—Location of Reagan and Upton Counties in Texas.

Physiography, Relief, and Drainage

Reagan County and most of Upton County are in the western part of the Edwards Plateau Major Land Resource Area. The western part of Upton County is in the Trans-Pecos Major Land Resource Area.

The Edwards Plateau, in the northern part of the survey area, has a smooth, nearly level landscape. The soils developed from a combination of materials deposited by water and wind (fig. 2).

The depth to limestone bedrock varies from a few feet to 30 feet. Much of the area drains to intermittent lakes that are 2 to 20 feet lower than the surrounding plains. Other areas drain to Centralia Draw, a tributary of the Middle Concho River.

In the southern part of the survey area, the Edwards Plateau consists of flat-topped hills where limestone either outcrops or is at shallow or very shallow depths (fig. 3).

In some places are alternating layers of hard limestone and marl. The valleys in the area have broad, flat floors. They were formed by streams that originally cut deep, V-shaped valleys that have partly refilled with water-laid deposits. In some places, the valley fill material is more than 100 feet thick. Drainage is south and southwest to the Pecos River.

The Trans-Pecos part of Upton County is a mixture of sands and loams, the Pecos River having been the main source of the materials. Some of the materials are ancient alluvial deposits, but most are windblown materials from ancient deposits.

Natural Resources

The most important natural resources to the economy are oil, natural gas, the soils, underground water, and wildlife.

As of 1984, almost a billion barrels of crude oil was produced in the two counties; however, this accounts for only part of the income generated by the petroleum industry. In 1983, about 30 million cubic feet of natural gas was produced in Reagan County alone. Many people are employed to service oil and gas wells, to work in the six natural gas plants, and to assist in drilling operations.

Agriculture generates about $15 million in annual income, mostly from lamb, wool, cattle, and cotton production. Almost two-thirds of the soils would be classified as prime farmland if they were irrigated. The soil best suited for farming is nearly level Reagan loam, which covers 661,524 acres.

No flowing streams are in either Reagan or Upton County. Underground water is of good quality in quantities adequate for home and livestock use in most areas (fig. 4).

The city of Big Lake gets its water from wells in the northern part of Reagan County. The northern part of Reagan and Upton Counties has a limited amount of underground water available for irrigation. Wells produce an average of about 40 gallons per minute but range from 25 to 90 gallons per minute. The average depth of water wells is 265 feet in Reagan County and 320 feet in Upton County. In 1984, Reagan County had 825 wells and Upton County had 460 wells. Ground water is pumped faster than it is replenished from rainfall, and its level is dropping 2 to 3 feet a year.

Wildlife is plentiful in the survey area. According to Aldo Leopold, wildlife represents the difference between rich country and mere land *(3)*. Reagan and Upton Counties are rich country. A wide variety of wildlife is not readily seen by travelers. Yet, all the state's big game animals are present except for wild sheep. Hundreds of species of birds live in or migrate through the survey area. Golden eagles winter there. More detailed information is in the section "Wildlife Habitat."

Climate

Reagan and Upton Counties have hot summers and fairly warm winters. Cold spells or snowfalls are rare. Rains usually are heaviest late in spring and early in fall. Rain during fall months is often associated with a dissipating tropical storm. Total annual precipitation usually is adequate for range vegetation; however, because of the high rate of evaporation, it

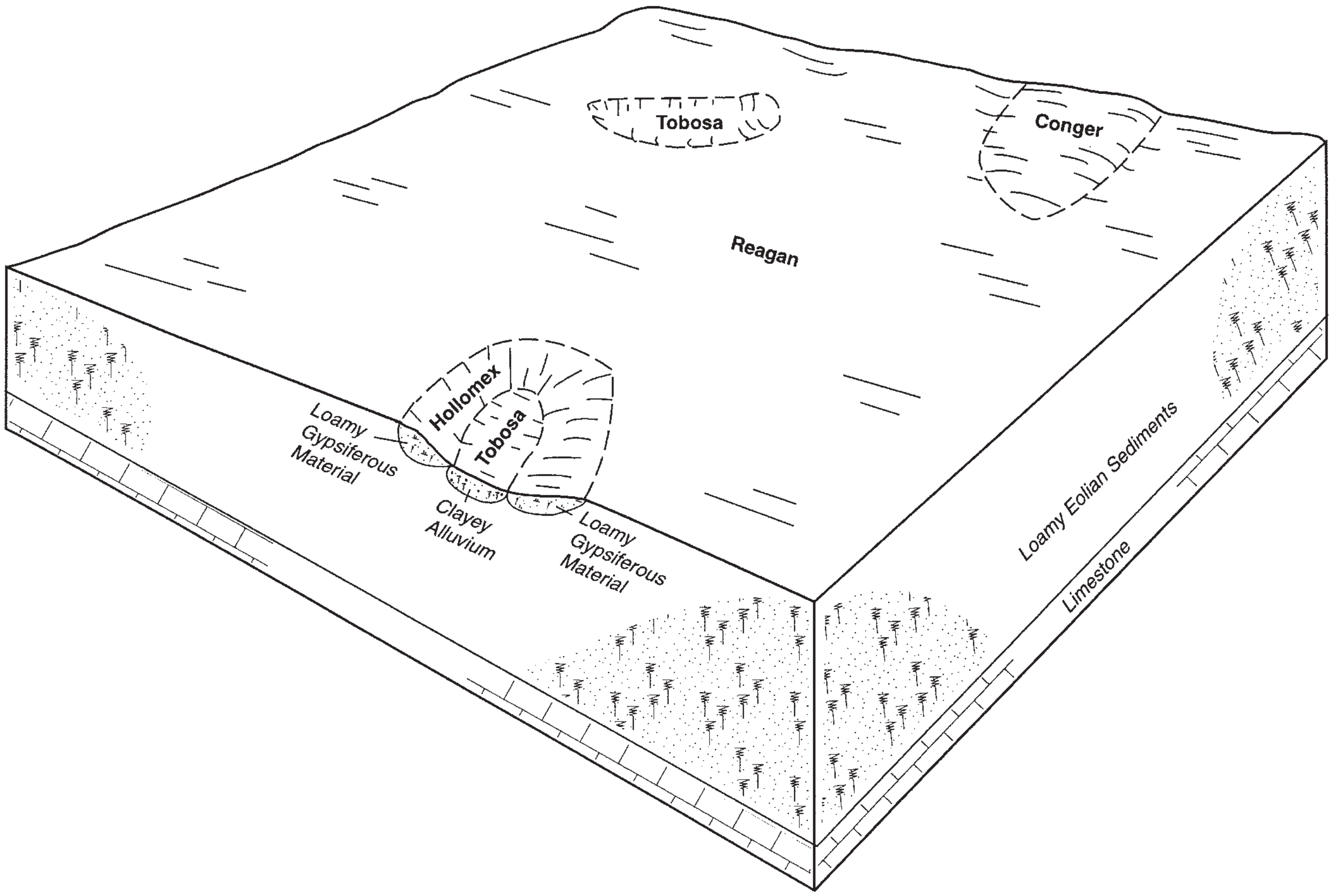

Figure 2.—Typical pattern of the soils in the northern part of the survey area.

often is not adequate for cotton, small grains, and sorghum without supplemental irrigation.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Big Lake, Texas, in the period 1964 to 1990; and at McCamey, Texas, in the period 1961 to 1990. The additional temperature and precipitation data recorded at McCamey, Texas, is included mainly to show the difference in the average amount of precipitation in the two counties. Tables 2 and 3 include data recorded at Big Lake, Texas, only. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 45 degrees F in Reagan County and 47 degrees F in Upton County. The average daily minimum temperature is 30 degrees F in Reagan County and 33 degrees F in Upton County. The lowest temperature for the period of record at Big Lake, Texas, is 1 degree, which occurred on January 29, 1980. In summer, the average temperature is 79 degrees F in Reagan County and 83 degrees F in Upton County. The average daily maximum temperature is 93 degrees F in Reagan County and 95 degrees F in Upton County. The highest temperature for the period of record at Big Lake, Texas, is 109 degrees, which occurred on June 29, 1980.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 19.4 inches in Reagan County and 14.3 inches in Upton County. In Reagan County 13 inches, or 67 percent, and in Upton County 9.5 inches, or 67 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 4.2 inches in Reagan County and 2.6 inches in Upton County. The heaviest 1-day rainfall during the period of

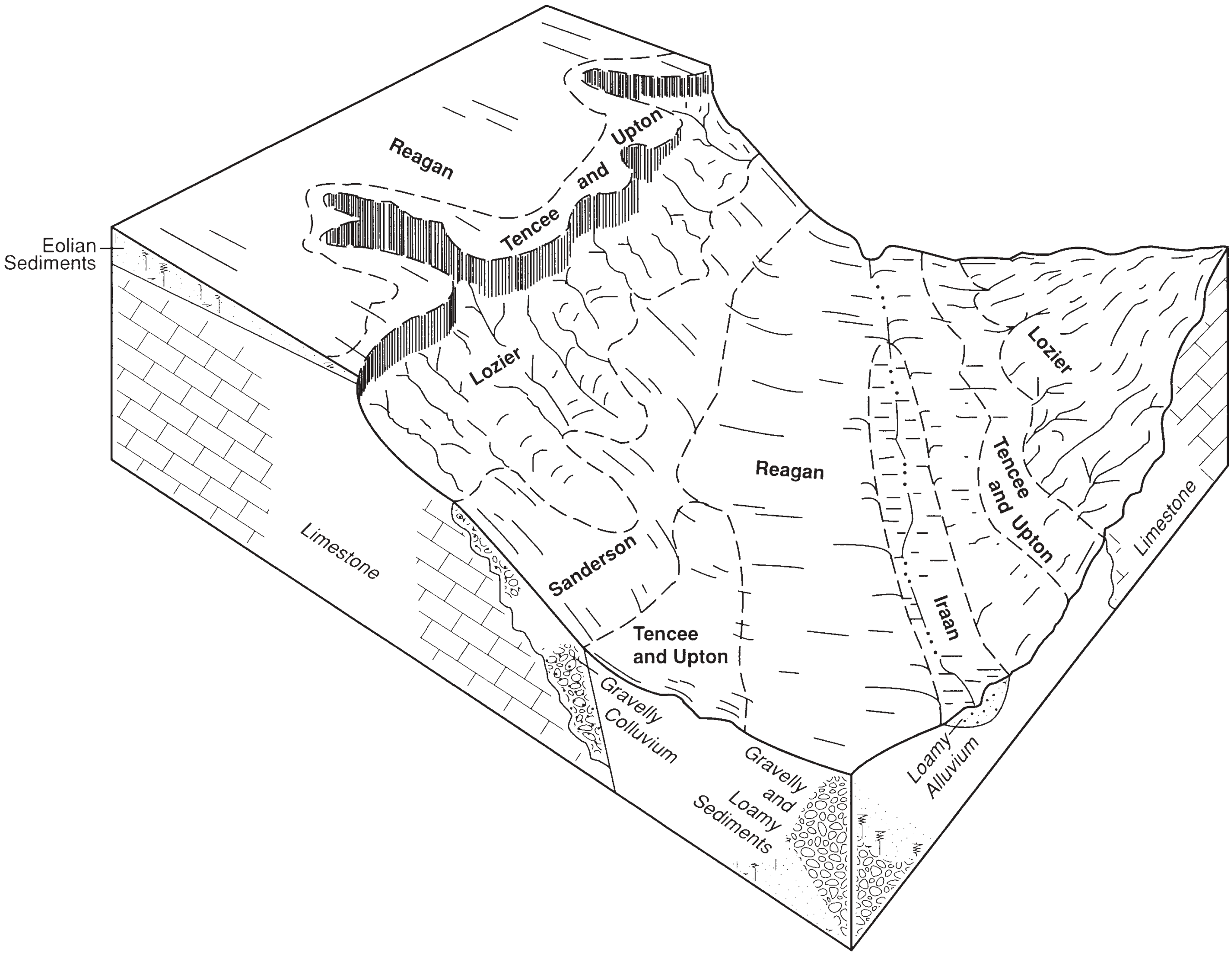

Figure 3.—Typical pattern of the soils in the southern part of the survey area.

record at Big Lake, Texas, was 4 inches on May 23, 1975. Thunderstorms occur on about 37 days each year, and most occur in June.

The average relative humidity in midafternoon is about 49 percent. Humidity is higher at night, and the average at dawn is about 78 percent. The sun shines 79 percent of the time possible in summer and 67 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in March.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific

segments of the landform, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are also assembled from research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are formed from farm records and from field or plot experiments on the same kinds of soil.

Figure 4.—Windmills are the traditional method of supplying water for livestock. In the foreground is Reagan loam, 0 to 1 percent slopes. In the background is Ector very gravelly loam, 1 to 8 percent slopes.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, and roads, all of which help in locating boundaries accurately.

On the soil maps at the back of this publication, section corners and fences are shown. Only those most helpful to the map user in finding specific areas are shown. The location of the fences and section corners are approximate and should not be used to determine property lines.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. In the detailed soil map units, these latter soils are called inclusions or included soils. In the general soil map units, they are called soils of minor extent.

Most included soils have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) included soils. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) included soils. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of included soils in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one map unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Reagan

Very deep, nearly level, loamy soils on uplands

This map unit consists of loamy soils on tarbush- and mesquite-covered areas interrupted only by scattered, intermittent, rounded lakes that range in depth from 2 to 20 feet. Irrigation water, in quantities adequate for light irrigation, underlies most areas of this map unit. There are no drainageways. The slopes are mainly less than 1 percent.

This map unit makes up 39 percent of the survey area. Reagan soils make up 90 percent of the map unit and other soils make up 10 percent.

Reagan soils typically have a brown, calcareous loam surface layer 8 inches thick. The subsoil is brown and light brown, calcareous loam 22 inches thick. From a depth of 30 to 80 inches, the soils are reddish yellow clay loam that has accumulations of calcium carbonate.

Soils of minor extent included in this map unit are Angelo, Conger, Hollomex, and Tobosa soils and areas of Oil-waste land. Angelo soils are darker in color and more clayey. Conger soils are shallow over indurated calcium carbonate and typically are at slightly higher elevations. Hollomex soils are on slopes adjacent to intermittent lakes. Tobosa soils are clayey. They are on beds of intermittent lakes. Plants will not grow on Oil-waste land because of petroleum or salt water spills.

Most of the irrigated cropland in the survey area is in this map unit. Cotton is the dominant crop. Much more land could be irrigated if the underground water supply were adequate. Most of the soils in this map unit are used as rangeland. Forage production is medium. Dwellings and roads can be easily built and maintained if they are designed to overcome the moderate potential of these soils for shrinking and swelling. Septic tank absorption fields work well. Corrosion of uncoated steel can be a problem on these soils.

2. Reagan-Conger

Very deep to shallow, nearly level and very gently sloping, loamy soils on uplands

This map unit consists of calcareous soils that are light in color. In some places, surface runoff drains into intermittent lakes, but most flows into small, low gradient drainageways. The valleys are broad and shallow. Common woody plants are mesquite and tarbush. Slopes range from 0 to 3 percent.

This map unit makes up 33 percent of the survey area. Reagan soils make up 67 percent of the map unit, Conger soils make up 25 percent, and other soils make up 8 percent.

Reagan soils typically have a brown, calcareous loam surface layer 8 inches thick. The upper part of the subsoil is brown and light brown loam 22 inches thick. The lower part, from a depth of 30 to 80 inches, is reddish yellow clay loam that has accumulations of calcium carbonate. Below a depth of 62 inches, the subsoil is reddish yellow clay loam that has lesser amounts of calcium carbonate.

Conger soils typically are at a slightly higher elevation on the landscape than Reagan soils. They have a brown loam surface layer 8 inches thick. The subsoil is pale brown loam 7 inches thick. From a depth of 15 to 21 inches is pinkish white indurated calcium carbonate. The underlying material, below a depth of 21 inches, is pinkish white gravelly clay loam.

Soils of minor extent included in this map unit are Angelo, Ector, Lozier, Tencee, and Tobosa soils. Angelo soils are darker in color and more clayey. Ector and Lozier soils are underlain by limestone. Tencee soils are gravelly. Tobosa soils are clayey and on beds of intermittent lakes.

Most of the soils in this map unit are used as rangeland. A few areas are cropland. Forage production is medium or low. Reagan soils could be used as cropland if irrigation water were available. Dwellings and roads can be easily built and maintained on these soils when designed to overcome the moderate potential of Reagan soils to shrink and swell. Septic tank absorption fields work well in Reagan soils. They work well in Conger soils if the indurated calcium carbonate layer is broken up or removed. Corrosion of uncoated steel can be a problem on these soils.

3. Lozier-Tencee

Very shallow and shallow, gently undulating to very steep, loamy, very gravelly soils on uplands

This map unit consists of very gravelly soils that are light in color and underlain by limestone or indurated calcium carbonate. These soils are on the steepest slopes and highest hills in the survey area. The steepest areas, in addition to being very gravelly, have many stones and short, nearly vertical rock outcrops. The woody vegetation consists of mesquite and several kinds of shrubs. All areas of this map unit are at the heads of drainageways that are tributaries of the Pecos River. Slopes range from 1 to 55 percent.

This map unit makes up 12 percent of the survey area. All mapped areas are in Upton County. Lozier soils make up 43 percent of the map unit, Tencee soils make up 17 percent, and other soils make up 40 percent.

The very gently sloping to steep Lozier soils are at the highest elevations on the landscape. They typically are pale brown very gravelly loam. They are underlain by limestone bedrock at a depth of about 12 inches.

Tencee soils typically have a pale brown, very gravelly loam surface layer 11 inches thick. Indurated calcium carbonate is at a depth of 11 to 24 inches. Very pale brown or pinkish white very gravelly loam is at a depth of 80 inches or more.

Soils of minor extent included in this map unit are Conger, Ector, Reagan, Sanderson, and Upton soils. Conger and Upton soils are less gravelly. Ector soils are darker in color. Reagan and Sanderson soils are very deep.

The soils in this map unit are used as rangeland. Forage production from mid and short grasses is low because the rooting depth is shallow or very shallow and the soils are droughty.

The bedrock underlying Lozier soils limits excavations, grading for roads, and building sites. The indurated calcium carbonate underlying Tencee soils also interferes with excavation; however, it can be broken up with heavy equipment. Septic tank absorption fields do not work well in Lozier soils. They work well in Tencee soils after the indurated calcium carbonate is broken or removed. Corrosion of uncoated steel can be a problem on these soils.

4. Ector-Conger

Very shallow and shallow, gently sloping or gently undulating to hilly, loamy soils on uplands; most are very gravelly

This map unit consists of soils that are grayish brown, very gravelly loam underlain by limestone bedrock and of soils that are brown loam underlain by indurated calcium carbonate. These soils are near the upper reaches of drainageways that are tributaries of the Concho River. Woody vegetation includes juniper and mesquite. Slopes range from 1 to 30 percent.

This map unit makes up 6 percent of the survey area. Most is in Reagan County. Ector soils make up 55 percent of the map unit, Conger soils make up 25 percent, and other soils make up 20 percent.

Typically, Ector soils are at higher elevations on the landscape. They have a grayish brown very gravelly loam surface layer 14 inches thick underlain by limestone bedrock.

Typically, Conger soils have a brown loam surface layer 8 inches thick. The subsoil is pale brown loam 7 inches thick. Pinkish white indurated calcium carbonate is at a depth of 15 to 21 inches. The underlying material, below a depth of 21 inches, is pinkish white, calcareous clay loam.

Soils of minor extent included in this map unit are Angelo, Reagan, and Tobosa soils. These soils are very deep. Also, Angelo soils are more clayey; Reagan soils are underlain by soft, calcareous materials; and Tobosa soils are more clayey and occur on the beds of intermittent lakes.

The soils in this map unit are used as rangeland. Their available water capacity is very low. The forage production from mid and short grasses is medium on Ector soils and low on Conger soils.

Excavation and grading of roads and building sites are difficult on Ector soils because of the shallow depth to bedrock. The indurated calcium carbonate underlying Conger soils also interferes with excavation; however, it can be broken up with

heavy equipment. Septic tank absorption fields do not work well in Ector soils. They work well in Conger soils after the indurated calcium carbonate layer is broken. Corrosion of uncoated steel can be a problem with these soils.

5. Iraan-Rioconcho-Reagan

Very deep, nearly level to gently sloping, loamy soils on flood plains and uplands

This map unit consists of very deep soils on flood plains and valley floors. The valleys are broad and flat. The stream channels are distinct, but not meandering or winding. The woody vegetation is mostly mesquite and shrubs. Slopes are 0 to 3 percent.

This map unit makes up 5 percent of the survey area. Iraan soils make up 25 percent of the map unit, Rioconcho soils make up 25 percent, Reagan soils make up 25 percent, and other soils make up 25 percent.

The nearly level Iraan soils are on flood plains that are occasionally flooded. They typically have a grayish brown silty clay loam surface layer 25 inches thick. The subsoil, from a depth of 25 to 80 inches, is light yellowish brown and very pale brown silty clay loam.

Rioconcho soils are on nearly level flood plains that are occasionally flooded. They typically have a dark grayish brown silty clay loam surface layer 16 inches thick. Brown silty clay loam is at a depth of 16 to 30 inches. The subsoil, from a depth of 30 to 80 inches, is light brown silty clay.

The nearly level to gently sloping Reagan soils typically are adjacent to the flood plain soils on both sides of stream channels and are above normal overflow. Reagan soils typically have a brown, calcareous loam surface layer 8 inches thick. The subsoil is light brown clay loam 22 inches thick. Reddish yellow clay loam that has accumulations of calcium carbonate is at a depth of 30 to 80 inches.

Soils of minor extent included in this map unit are Angelo, Conger, and Ector soils. Angelo soils are very deep and have a silty clay loam surface layer that is dark in color. Conger soils are shallow over indurated calcium carbonate. Ector soils are gravelly and shallow or very shallow over hard limestone.

The soils in this map unit are used as rangeland. Forage production is high on Iraan and Rioconcho soils and medium on Reagan soils. Dwellings and other permanent structures and septic tank absorption fields are not suited to Iraan and Rioconcho soils because of the hazard of flooding. These uses are suited to Reagan soils if designed to overcome the moderate potential for shrinking and swelling. Corrosion of uncoated steel can be a problem with the soils in this map unit.

6. Angelo-Noelke-Mereta

Very deep to very shallow, nearly level to gently sloping, loamy soils on uplands

This map unit consists of soils in the southeast corner of the survey area. The landscape is a high, nearly level divide. Drainageways flow into intermittent lakes and toward the Concho River. The most common woody plant is mesquite. Slopes range from 0 to 5 percent.

This map unit makes up 2 percent of the survey area. Angelo soils make up 46 percent of the map unit, Noelke soils make up 29 percent, Mereta soils make up 16 percent, and other soils make up 9 percent.

Angelo soils typically have a grayish brown silty clay loam surface layer 11 inches thick. The subsoil, from a depth of 11 to 30 inches, is brown silty clay. From a depth of 30 to 80 inches, it is pinkish white silty clay loam that has accumulations of calcium carbonate.

The shallow and very shallow Noelke soils typically have a very gravelly silty clay loam surface layer that is 12 inches thick and that is grayish brown in the upper part and brown in the lower part. Pinkish white indurated calcium carbonate is at a depth of 12 to 15 inches. Very pale brown limestone bedrock is at a depth of 15 to 80 inches.

The shallow Mereta soils typically have a mostly grayish brown clay loam surface layer 18 inches thick. The subsoil, from a depth of 18 to 25 inches, is pinkish white indurated calcium carbonate. The underlying material, from a depth of 25 to 80 inches, is pinkish white gravelly clay loam.

Soils of minor extent included in this map unit are Conger, Reagan, and Tobosa soils. Conger soils are shallow soils that are light in color. Reagan soils are very deep and have a surface layer that is light in color. Tobosa soils are very deep, clayey soils on beds of intermittent lakes.

The soils in this map unit are used as rangeland. Forage production is medium. Dwellings and other permanent structures must be designed to overcome the high shrink-swell potential of Angelo soils and the moderate shrink-swell potential of Mereta soils. Special designs are needed for septic tank absorption fields on Angelo and Mereta soils because of their moderately slow permeability.

7. Kinco-Wickett-Pyote

Very deep to moderately deep, nearly level and very gently sloping, loamy and sandy soils on uplands

Most of the soils in this map unit are on a landscape that has very little relief and poorly defined drainageways. In areas of sandy soils, the landscape has undulating relief, due mostly to dunes that are now stabilized by vegetation. The woody vegetation includes shinnery oak and mesquite. Slopes are 0 to 3 percent.

This map unit makes up 2 percent of the survey area. Kinco fine sandy loam makes up 50 percent of the map unit, Wickett loamy fine sand makes up 15 percent, Pyote loamy fine sand makes up 10 percent, and other soils make up 25 percent.

The loamy Kinco soils typically are on broad, nearly level plains. They have a light brown fine sandy loam surface layer 12 inches thick. The subsoil, from a depth of 12 to 33 inches, is pink fine sandy loam and from a depth of 33 to 60 inches, it is pink loam that has accumulations of calcium carbonate. From a depth of 60 to 80 inches, the subsoil is pink loam that has less calcium carbonate.

The sandy Wickett soils typically are very gently sloping. Low dunes are in some places. These soils formed in loamy eolian materials. They have a noncalcareous, strong brown loamy fine sand surface layer 16 inches thick. The noncalcareous subsoil, from a depth of 16 to 24 inches, is strong brown fine sandy loam. From a depth of 24 to 33 inches, it is yellowish red fine sandy loam. Pinkish white indurated calcium carbonate is at a depth of 33 to 49 inches. The underlying material, from a depth of 49 to 80 inches, is soft, pinkish white gravelly loam that has much less calcium carbonate.

The sandy Pyote soils are noncalcareous. They are gently sloping. Low dunes are in some places. These soils formed in sandy eolian and alluvial materials. They typically have a brown loamy fine sand surface layer 24 inches thick. The subsoil, from a depth of 24 to 42 inches, is strong brown fine sandy loam. From a depth of 42 to 60 inches, it is yellowish red fine sandy loam, and from a depth of 60 to 80 inches, it is reddish yellow loamy fine sand.

Soils of minor extent included in this map unit are Blakeney, Penwell, Reagan, Tencee, and Upton soils. Blakeney soils are loamy and shallow over indurated calcium carbonate. Penwell soils are sandy and very deep. Reagan soils are very deep, calcareous, loamy soils. Tencee and Upton soils are shallow, gravelly or very gravelly soils.

The soils of this map unit are used as rangeland. Forage production is low or medium. The hazard of wind erosion is a severe problem when the soils are bare. Septic tank absorption fields take up water readily; however, they can pollute underground water supplies in wells nearby.

8. Reeves-Hollomex-Ekal

Very deep to shallow, nearly level to gently sloping and undulating, clayey and loamy soils on uplands

This map unit consists of clayey soils in intermittent lakes and soils formed in gypsiferous materials. Drainageways flow into intermittent lakes. The lakebeds are concave and nearly level. Soils formed in gypsiferous materials surround the lakes at higher elevations. They have convex slopes. Slopes range from 0 to 8 percent.

This map unit makes up 1 percent of the survey area. Reeves soils make up 31 percent of the map unit, Hollomex soils make up 25 percent, Ekal soils make up 22 percent, and other soils make up 22 percent.

Reeves soils are nearly level to gently sloping and are underlain by gypsiferous materials. They typically have a light gray loam surface layer 16 inches thick. The subsoil, from a depth of 16 to 22 inches, is very pale brown loam that has a few small masses of calcium carbonate. White, gypsiferous silty clay loam is at a depth of 22 to 80 inches.

The shallow Hollomex soils are undulating. They typically have a light gray loam surface layer 11 inches thick. Weakly cemented gypsiferous loam is at a depth of 11 to 80 inches.

The very deep and strongly saline Ekal soils are in the concave beds of intermittent lakes. They typically have a gray clay surface layer 15 inches thick. The subsoil, from a depth of 15 to 48 inches, is light gray clay. The underlying material, from a depth of 48 to 80 inches, is light gray to white clay loam.

Soils of minor extent included in this map unit are Angelo, Conger, and Reagan soils. Angelo soils are very deep and have a silty clay loam surface layer that is dark in color. Conger soils are shallow, loamy soils that are underlain by indurated calcium carbonate. Reagan soils are very deep, loamy soils that are light in color. Unlike Reagan soils, Reeves soils are underlain by gypsiferous materials.

The soils in this map unit are used as rangeland. Forage production is low or medium. Dwellings and other permanent structures should not be built on Ekal soils because of occasional flooding by runoff from surrounding soils. Corrosion of uncoated steel can be a problem on these soils.

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given under the heading "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Angelo silty clay loam, 0 to 1 percent slopes, is a phase of the Angelo series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are associations or undifferentiated groups.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the

soils or miscellaneous areas are somewhat similar. Conger-Reagan association, 0 to 3 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Tencee and Upton soils, 1 to 8 percent slopes, is an undifferentiated group in this survey area.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Oil-waste land is an example.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see “Summary of Tables”) give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

AnA—Angelo silty clay loam, 0 to 1 percent slopes

This very deep, nearly level soil formed in calcareous loamy and clayey materials. It is in long, narrow valleys and on outwash plains. All areas of this soil are in Reagan County.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 11 inches, grayish brown silty clay loam

Subsoil:
11 to 30 inches, brown silty clay
30 to 80 inches, pinkish white silty clay loam that in the upper part is 10 percent, by volume, visible calcium carbonate that gradually diminishes with depth

Important soil properties—

Drainage: Well drained
Runoff: Negligible
Permeability: Moderately slow
Available water capacity: High
Hazard of wind erosion: Slight
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: High

Included with this soil in mapping are small areas of gravelly soils in intermittent stream channels and Rioconcho soils on adjacent flood plains. In the northeast part of Reagan County, some areas of included soils are underlain by hard limestone at a depth of 48 to 60 inches. The included soils make up about 15 percent of the map unit.

Most areas of this soil are used as rangeland. Major concerns are suppressing mesquite and maintaining an adequate plant cover to help prevent erosion. Timely deferments of grazing are needed to allow plants to produce seed. Most areas of this soil receive and absorb some runoff from adjacent higher soils, thereby partly offsetting the low amount of rainfall.

This soil is suitable for cropland when irrigated. A small acreage in the northern part of Reagan County is cropland. A properly designed irrigation system and proper application of irrigation water are necessary to conserve the limited water supply. A wide variety of crops can be grown on this soil; however, the small water supply limits choices to the most drought-resistant crops. As the water supply diminishes, farmers sometimes choose to irrigate only small acreages of higher value crops. Proper use of fertilizer is required for optimum yields.

This soil is suitable for most urban uses; however, special designs are needed. Septic tank absorption fields must be large because the permeability is moderately slow. Subgrades for roads and foundations for buildings must be properly designed to accommodate the high potential for shrinking and swelling caused by changes in moisture. Impoundments are hard to seal because the soil is calcareous. The risk of corrosion of underground, uncoated steel pipe is high.

This Angelo soil is in capability subclass 3c nonirrigated, 1 irrigated, and in the Clay Loam range site.

AnB—Angelo silty clay loam, 1 to 3 percent slopes

This soil is very deep and gently sloping. It formed in calcareous loamy and clayey materials. It is in valleys in long, narrow areas that are above overflow. All areas of this soil are in Reagan County.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 12 inches, grayish brown silty clay loam
12 to 25 inches, brown silty clay
25 to 80 inches, light brown clay loam that in the upper part contains many soft masses of calcium carbonate that diminish with depth

Important soil properties—

Drainage: Well drained
Runoff: Very low
Permeability: Moderately slow
Available water capacity: High
Hazard of wind erosion: Slight
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: High

Included with this soil in mapping are small, gravelly stream channels that are frequently flooded; areas of soils that are gravelly, lighter in color than the Angelo soil, and on rounded slopes adjacent to the channels; and Angelo soils that are nearly level. The included soils make up about 20 percent of the map unit.

Most areas of this soil are used as rangeland, mainly because of the low amount of rainfall and the absence of irrigation water. Suppressing mesquite and maintaining an adequate cover to reduce runoff and evaporation are primary concerns. Timely deferments of grazing are needed to allow plants to produce seed. Most areas receive and absorb some runoff from adjacent hills, thus partly offsetting the low amount of rainfall.

This soil is suited to cropland if irrigated; however, fields generally are very small and narrow.

This soil is suitable for most urban uses; however, special designs are needed. Septic tank absorption fields must be large because the permeability is moderately slow. Subgrades for roads and foundations for buildings must be designed to accommodate the potential for shrinking and swelling caused by changes in moisture. Impoundments are hard to seal because the soil is calcareous. The risk of corrosion of underground, uncoated steel pipe is high.

This Angelo soil is in capability subclass 3e nonirrigated, 2e irrigated, and in the Clay Loam range site.

BKB—Blakeney fine sandy loam, 1 to 3 percent slopes

This gently sloping soil is shallow to indurated calcium carbonate. It is on long, gentle footslopes. All areas of this soil are in Upton County.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 7 inches, brown fine sandy loam

Subsoil:
7 to 14 inches, strong brown fine sandy loam
14 to 25 inches, white, indurated calcium carbonate

Underlying material:
25 to 80 inches, white gravelly loam

Important soil properties—

Drainage: Well drained
Runoff: High
Permeability: Moderately rapid in upper part, very slow in the indurated layer
Available water capacity: Very low
Hazard of wind erosion: Severe
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Kinco, Tencee, and Upton soils and shallow soils that do not have a layer of indurated calcium carbonate. Kinco soils are very deep and typically are in broad valleys. Tencee and Upton soils are gravelly. The included soils make up 15 percent of the map unit.

All areas of this soil are used as rangeland. Maintaining an adequate plant cover to prevent wind erosion and to reduce evaporation is a major concern. Timely deferments of grazing are needed to enable plants to stay vigorous and to produce seed. As brush increases, the better forage plants are robbed of moisture; however, it provides some protection from soil blowing and improves the habitat for wildlife.

This soil is not suited to cropland because of shallow depth, very low available water capacity, and low amount of rainfall.

This soil has severe limitations for most urban and engineering uses. If the layer of indurated calcium carbonate at a shallow depth is removed, the underlying material is more suitable for excavations, septic tank absorption fields, foundations, and impoundments. The risk of corrosion of underground, uncoated steel pipe and excessive seepage from impoundments are also limitations.

This Blakeney soil is in capability subclass 6e and in the Shallow range site.

CrB—Conger-Reagan association, 0 to 3 percent slopes

These nearly level to gently sloping soils formed in calcareous, loamy materials. They are on broad plains, tops of limestone hills, and low knolls. The Conger soil is shallow to a cemented pan. It typically is at slightly higher elevations on the landscape than the very deep Reagan soil and has slightly convex slopes.

This map unit is about 50 percent Conger soil, 30 percent Reagan soil, and 20 percent other soils. These

soils are so intricately mixed that mapping them separately is not practical at the scale used.

The typical sequence, depth, and composition of the layers of the Conger soil are—

Surface layer:
0 to 8 inches, brown loam

Subsoil:
8 to 15 inches, pale brown loam containing 5 percent calcium carbonate concretions from 0.125 to 2.0 inches across
15 to 21 inches, pinkish white, indurated calcium carbonate fragments

Underlying material:
21 to 80 inches, pinkish white clay loam that has indurated calcium carbonate gravel

Important soil properties—

Drainage: Well drained
Runoff: Low or medium
Permeability: Moderate in the upper part, very slow in the indurated layer
Available water capacity: Very low
Hazard of wind erosion: Moderate
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

The typical sequence, depth, and composition of the layers of the Reagan soil are—

Surface layer:
0 to 8 inches, brown loam

Subsoil:
8 to 30 inches, light brown clay loam
30 to 50 inches, reddish yellow clay loam, 35 percent fine concretions and powdery calcium carbonate
50 to 80 inches, reddish yellow clay loam, 5 percent fine calcium carbonate bodies

Important soil properties—

Drainage: Well drained
Runoff: Very low
Permeability: Moderate
Available water capacity: Moderate
Hazard of wind erosion: Moderate
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: Moderate

Included with these soils in mapping are small areas of Tencee and Upton soils and deep, loamy soils that do not have a layer of accumulated calcium carbonate. Also included are shallow, loamy soils underlain by hard limestone. The included soils make up 20 percent of the map unit.

Most areas of these soils are used as rangeland. A few areas are used as cropland. A major concern is suppressing mesquite and maintaining an adequate cover to protect the soil from erosion, to reduce evaporation, and to keep the water intake rate as high as possible. Timely deferments of grazing are needed to enable plants to stay vigorous and to produce seed.

This map unit is typically unsuitable for use as cropland because on the shallow Conger soil surface runoff is medium and available water capacity is very low. The Reagan soil could be cultivated if irrigated; however, fields would be small.

The Reagan soil is suitable for most urban and engineering uses. The Conger soil can be modified with heavy equipment for these uses. Subgrades for roads and foundations for buildings must be properly designed because of the potential for shrinking and swelling caused by changes in moisture. These soils are corrosive to underground, uncoated steel pipe and have low strength for road and street construction. Seepage is a limitation for impoundments, and the high content of lime in the subsoil and underlying material make the soils difficult to seal. Septic tank absorption fields work well in the Reagan soil. On the Conger soil, indurated calcium carbonate at a shallow depth must be excavated with heavy equipment to make the soil suitable for septic tank absorption fields. This indurated layer makes excavations difficult and interferes with the construction of roads and small buildings.

This map unit is in capability subclass 6e. The Conger soil is in the Shallow range site, and the Reagan soil is in the Loamy range site.

ECC—Ector very gravelly loam, 3 to 8 percent slopes

This soil is very shallow or shallow to limestone bedrock. Slopes are gently undulating or undulating. This soil is on tops and sides of low hills, mainly in the eastern part of the survey area. The areas are irregular in shape and typically are large, ranging from 20 to many thousand acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 6 inches, grayish brown very gravelly loam, 50 percent indurated calcium carbonate and limestone fragments from 1 to 20 inches across covering 75 percent of the surface

Subsoil:
6 to 14 inches, grayish brown very cobbly loam, 60 percent indurated calcium carbonate and limestone fragments

Underlying material:
14 to 30 inches, white limestone bedrock with indurated calcium carbonate sealing cracks
30 to 80 inches, white, horizontally bedded, fractured limestone bedrock

Important soil properties—

Drainage: Well drained
Runoff: Very high
Permeability: Moderate
Available water capacity: Very low
Hazard of wind erosion: Slight
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Angelo, Lozier, and Noelke soils. Angelo soils are very deep and are in small drainageways. Lozier soils are lighter in color than the Ector soil, and are in sloping to steep areas where they absorb less water. Noelke soils have less carbonates and commonly are in less sloping areas. Also included, on hillsides, are horizontal, narrow beds of rock outcrops that have little or no vegetation. The included soils make up about 10 percent of the map unit.

This soil is used as rangeland (fig. 5). A major concern is maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable plants to stay vigorous and to produce seed.

This soil is not suitable for cropland. It is too shallow, too steep, and too gravelly.

This soil has severe limitations for most urban uses. Hard limestone at a depth of less than 20 inches affects excavations, septic tank absorption fields, impoundments, and foundations.

This Ector soil is in capability subclass 7s, and in the Limestone Hill range site.

ECE—Ector very gravelly loam, 8 to 30 percent slopes, very stony

This soil is shallow or very shallow to limestone bedrock. About 15 percent of the surface is covered with stones. The landscape is rolling to hilly. This soil is on hillsides in the eastern part of the survey area. Areas are irregular in shape and most are large, ranging from 20 to many thousand acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 5 inches, brown very gravelly loam, 45 percent indurated calcium carbonate and limestone fragments from 0.25 to 24.0 inches across that cover 90 percent of surface

Subsoil:
5 to 12 inches, brown very gravelly loam, 75 percent indurated calcium carbonate and limestone fragments from 0.25 to 24.0 inches across

Underlying material:
12 to 36 inches, white limestone with indurated calcium carbonate sealing cracks
36 to 80 inches, white, horizontally bedded, fractured limestone

Important soil properties—

Drainage: Well drained
Runoff: Very high
Permeability: Moderate
Available water capacity: Very low
Hazard of wind erosion: Slight
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Lozier and Noelke soils. Lozier soils are lighter in color and are in areas where they receive less water than the Ector soil. Noelke soils have less carbonates than the Ector soil and commonly are in the less sloping areas. Also included, on hillsides, are horizontal, narrow beds of rock outcrop that have little or no vegetation. The included soils make up about 10 percent of the map unit.

This soil is used for rangeland. A major concern is maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This soil is not suitable for cropland. It is too shallow and too steep and has too many limestone fragments.

This soil has severe limitations for most urban and engineering uses because of steep slopes and hard limestone at a depth of less than 20 inches. It affects excavations, septic tank absorption fields, impoundments, and foundations.

This Ector soil is in capability subclass 7s and in the Steep Rocky range site.

Figure 5.—An area of Ector very gravelly loam, 3 to 8 percent slopes. This rangeland is in good condition.

EKA—Ekal clay, 0 to 1 percent slopes, depressional

This soil is very deep and strongly saline. It is on beds of intermittent lakes that are 20 to 50 feet lower than the surrounding plains. Surface runoff sufficient to pond water occurs once every 2 to 10 years and remains from 1 week to 6 months. The two areas of this soil are in Slager Lake and Big Lake. Slopes are nearly level and concave.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 8 inches, gray clay, moderately saline, moderately sodic
8 to 15 inches, gray clay, strongly saline, moderately sodic

Subsoil:
15 to 22 inches, light gray clay, strongly saline, strongly sodic
22 to 36 inches, light gray clay, strongly saline, moderately sodic, few white aggregates of salts
36 to 48 inches, gray clay, strongly saline, moderately sodic, few white aggregates of salts

Underlying material:
48 to 57 inches, light gray clay loam, strongly saline, moderately sodic
57 to 80 inches, white clay loam, strongly saline, moderately sodic, 15 percent gypsum crystals

Important soil properties—

Drainage: Somewhat poorly drained
Runoff: Negligible
Permeability: Very slow
Available water capacity: Low

Hazard of wind erosion: Moderate
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: High

Included with this soil in mapping are small areas of soils that are around the edges of the lakebed and that have less salinity or are less alkaline. The included soils make up about 10 percent of the map unit.

All areas of this soil are used as rangeland. Production is low because of the salinity. Even when the soil appears to be moist, the water is not available to most plants. Only the most salt-tolerant plants can survive on this soil. If water remains on the surface for more than 3 days, most plants will drown.

This soil is not suitable as cropland because of the salinity.

This soil is poorly suited to most urban and engineering uses. Because of the high clay content of this soil, which causes shrinking and swelling with changes in moisture, extremely strong foundations for buildings and adequate subgrades for roads are required. The risk of corrosion of uncoated steel is high. Excavations are difficult and very dangerous because sidewalls can cave in without warning. Buildings and septic tank absorption fields are not suited to this soil because of ponding and periodic wetness from a perched water table.

This Ekal soil is in capability subclass 6w and in the Saline Lakebed range site.

HMC—Hollomex loam, 1 to 8 percent slopes

This soil is shallow to weakly cemented gypsiferous materials. It is around intermittent lakes, and the widest areas are on the north and northeast sides of the lakes. Slopes are convex. Areas are rounded and range from 10 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 10 inches, light gray loam

Subsoil:
10 to 30 inches, white loam, calcareous and gypsiferous

Underlying material:
30 to 80 inches, white loam, weakly cemented and gypsiferous

Important soil properties—

Drainage: Well drained
Runoff: Very low or medium
Permeability: Moderate
Available water capacity: Very low
Hazard of wind erosion: Moderate
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Reeves soils and very shallow soils. Reeves soils are deeper to gypsiferous materials and are lower on the landscape. The very shallow soils are on the tops of knolls and are less than 2 inches deep over gypsiferous materials. The included soils make up about 20 percent of the map unit.

This soil is used as rangeland, although forage production is very low (fig. 6). A major concern is maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This soil is not suitable for cropland because of shallow depth and slope.

This soil is suitable for most urban and engineering uses. It is easily excavated and the underlying material makes strong foundations. However, the risk of corrosion of uncoated steel is high because the soil is very slightly saline. Septic tank absorption fields work well in this soil.

This Hollomex soil is in capability subclass 7s and in the Gyp range site.

Ir—Iraan silty clay loam, occasionally flooded

This very deep, nearly level, alluvial soil is on flood plains of larger streams in the western part of the survey area. It is occasionally flooded by stream overflow and receives extra water from adjacent, higher-lying soils. The chance of flooding in any year is 5 to 50 percent. Duration is less than 2 days. Slopes are less than 1 percent. Areas are long and narrow and range from 30 to several thousand acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 4 inches, brown silty clay loam
Subsurface layer:
4 to 25 inches, grayish brown silty clay loam

Subsoil:
25 to 40 inches, light yellowish brown silty clay loam
40 to 80 inches, light yellowish brown silty clay loam that has masses of calcium carbonate

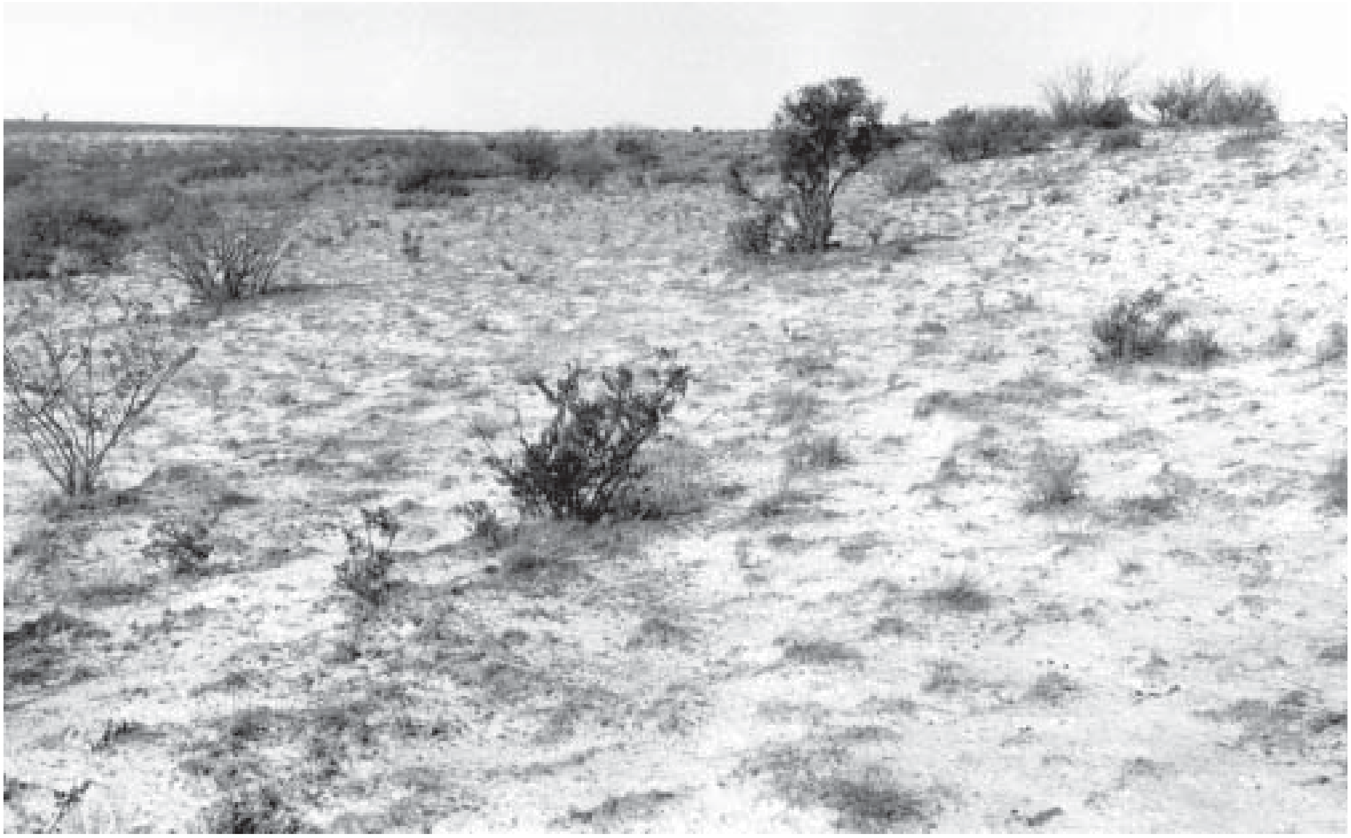

Figure 6.—An area of Hollomex loam, 1 to 8 percent slopes. Typically, plant cover is sparse and forage production is very low on this soil.

Important soil properties—

Drainage: Well drained
Runoff: Negligible
Permeability: Moderately slow
Available water capacity: High
Hazard of wind erosion: Moderate
Hazard of water erosion: Slight
Hazard of flooding: Occasional, very brief
Shrink-swell potential: Moderate

Included with this soil in mapping are stream channels and small areas of Reagan soils that are lighter in color than the Iraan soil and that are above normal overflow. The stream channels consist of gravelly materials deposited by recent floods. They have variable amounts of gravel, sand, silt, and clay. The included soils make up about 10 percent of the map unit.

This soil is used as rangeland. Major concerns are suppressing mesquite and maintaining an adequate plant cover to reduce evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed. Most areas receive and absorb some runoff from adjacent surrounding slopes, which partly reduces the effects of low rainfall.

Crops could be grown on this soil if irrigation water were available. At present, no sources are available.

This soil is not suited to most urban and engineering uses. Homes and other permanent structures should not be built on this soil because of the hazard of flooding.

This Iraan soil is in capability subclass 6w nonirrigated, 2w irrigated, and in the Draw range site.

KNB—Kinco fine sandy loam, 0 to 2 percent slopes

This nearly level, very deep soil is in broad valleys in the western part of Upton County. Areas are irregular in shape and range from 10 to 400 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 12 inches, light brown fine sandy loam

Subsoil:
12 to 33 inches, pink fine sandy loam
33 to 60 inches, pink loam, 10 percent calcium carbonate concretions
60 to 80 inches, pink loam

Important soil properties—

Drainage: Well drained
Runoff: Negligible
Permeability: Moderately rapid
Available water capacity: Moderate
Hazard of wind erosion: Severe
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Reagan, Tencee, Upton, and Wickett soils. Reagan soils have a loam surface layer and are in positions on the landscape similar to those of the Kinco soil. Tencee and Upton soils are shallow and are in higher positions than the Kinco soil. Wickett soils have a sandy surface layer and are underlain by indurated calcium carbonate at a depth of about 33 inches. Typically, they are higher on the landscape. The included soils make up about 20 percent of the map unit.

This soil is used as rangeland. Major concerns are suppressing mesquite and maintaining an adequate plant cover to reduce wind erosion and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This soil is suitable for growing irrigated crops. However, at present, no sources of irrigation water are available.

This soil is suitable for most urban and engineering uses. It is easily excavated, has little risk of shrinking and swelling with changes in moisture content, and makes strong foundations when the soil is confined. It is corrosive to underground, uncoated steel pipe. Seepage is a problem when it is used for impoundments. The soil is suited to septic tank absorption fields.

This Kinco soil is in capability subclass 6e and in the Sandy Loam range site.

LZD—Lozier very gravelly loam, 2 to 15 percent slopes

This soil is very shallow or shallow to hard limestone bedrock. It is gently undulating to rolling. It is on tops and sides of hills in the western part of the survey area. The areas are irregular in shape and most are large, ranging from 20 to several thousand acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 4 inches, pale brown very gravelly loam, 35 percent limestone and indurated calcium carbonate fragments that are as much as 6 inches across and that cover 70 percent of surface

Subsoil:
4 to 12 inches, pale brown very gravelly loam, 60 percent limestone and indurated calcium carbonate fragments as much as 8 inches across

Underlying material:
12 to 24 inches, very pale brown hard limestone bedrock; cracks sealed with indurated calcium carbonate
24 to 80 inches, horizontally bedded, fractured limestone bedrock

Important soil properties—

Drainage: Well drained
Runoff: Very high
Permeability: Moderate
Available water capacity: Very low
Hazard of wind erosion: Slight
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Ector, Tencee, and Upton soils. Ector soils are darker in color and are in areas that receive more runoff than the Lozier soil. Tencee and Upton soils are underlain at a shallow depth by an indurated layer of calcium carbonate. They are in lower positions on the landscape. Also included are small areas of rock outcrop that have little or no vegetation. They are in horizontal, narrow bands on hillsides. The included soils make up about 20 percent of the map unit.

This soil is used as rangeland. A major concern is maintaining an adequate cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This soil is not suitable for cropland because of slope, limestone fragments, and the shallow or very shallow depth to bedrock.

This soil has severe limitations for most urban and engineering uses. Hard limestone at a depth of less than 20 inches affects excavations, septic tank absorption fields, foundations, and impoundments.

This Lozier soil is in capability subclass 7s and in the Limestone Hill range site.

LZG—Lozier very gravelly loam, 15 to 55 percent slopes, very stony

This soil is very shallow or shallow to hard limestone bedrock. It is on sides of hills in the western part of the survey area (fig. 7). Slopes are hilly to very steep. The areas are irregular in shape and most are large, ranging from 20 to several thousand acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 10 inches, pale brown very gravelly loam, 35 percent limestone and indurated calcium carbonate fragments that are as much as 16 inches across and that cover 70 percent of the surface

Subsoil:
10 to 14 inches, very pale brown very gravelly loam, 75 percent limestone and indurated calcium carbonate fragments as much as 22 inches across, the larger ones of which are flattened

Underlying material:
14 to 38 inches, white limestone bedrock; cracks sealed with indurated calcium carbonate
38 to 80 inches, white horizontally bedded, fractured limestone bedrock

Important soil properties—

Drainage: Well drained
Runoff: High
Permeability: Moderate
Available water capacity: Very low
Hazard of wind erosion: Slight
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Ector, Tencee, and Upton soils. Ector soils are darker in color and are in areas that receive more water than the Lozier soil. Tencee and Upton soils are underlain at a shallow depth by an indurated layer of calcium carbonate. They are in lower positions on the landscape. Also included is rock outcrop that occurs as horizontal, narrow beds on hillsides. These areas have little or no vegetation. The included soils make up about 20 percent of the map unit.

This soil is used as rangeland. A major concern is maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This soil is not suitable for cropland because of steep slopes, limestone fragments, and the shallow or very shallow depth to bedrock.

This soil has severe limitations for urban and engineering uses. The hilly to very steep slopes make the use of equipment difficult. Hard limestone at a depth of less than 20 inches affects excavations, septic tank absorption fields, foundations, and impoundments.

This Lozier soil is in capability subclass 7s and in the Steep Rocky range site.

MeA—Mereta clay loam, 0 to 1 percent slopes

This nearly level soil is shallow to a layer of strongly cemented calcium carbonate. It is on broad, flat plains and typically is a few inches higher on the landscape than the surrounding soils. Most areas of this soil are in the southeast part of Reagan County. Areas are irregular in shape and range from 10 to 400 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 5 inches, brown clay loam

Subsoil:
5 to 18 inches, brown clay loam, few to many fragments of indurated calcium carbonate that are 0.25 to 1.0 inch across and that increase with depth
18 to 25 inches, pinkish white, indurated calcium carbonate

Underlying material:
25 to 80 inches, pinkish white gravelly clay loam

Important soil properties—

Drainage: Well drained
Runoff: Low
Permeability: Moderately slow in the upper part, very slow in the indurated layer
Available water capacity: Low
Hazard of wind erosion: Moderate
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: Moderate

Included with this soil in mapping are small areas of Angelo, Ector, and Noelke soils. Angelo soils are very deep and are lower on the landscape. Ector and Noelke soils are less clayey than the Mereta soil and are very gravelly. They are on hillsides. The included soils make up 15 percent of the map unit.

Figure 7.—A typical area of Lozier very gravelly loam, 15 to 55 percent slopes, very stony.

This soil is used as rangeland. Major concerns are suppressing mesquite and maintaining an adequate plant cover to reduce evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This soil is suitable for cropland, but shallow rooting depth and droughty conditions are severe limitations. Irrigation would provide best results; however, at present adequate irrigation water is not available.

This soil is poorly suited for most urban and engineering uses. A layer of indurated calcium carbonate at a shallow depth affects septic tank absorption fields, excavations, and impoundments. A moderate potential for shrinking and swelling with

changes in moisture is a limitation. The risk for corrosion of underground, uncoated steel pipe is high.

This Mereta soil is in capability subclass 3s nonirrigated, 3s irrigated, and in the Shallow range site.

MeB—Mereta clay loam, 1 to 3 percent slopes

This soil is shallow to indurated calcium carbonate and is gently sloping. It is on broad plains and typically is a few feet higher on the landscape than the surrounding soils. Most of this soil is in the southeast part of Reagan County. Areas are irregular in shape and range from 10 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 5 inches, grayish brown clay loam, few indurated calcium carbonate fragments 0.25 to 2.0 inches across

Subsoil:
5 to 16 inches, grayish brown clay loam, 5 percent indurated calcium carbonate fragments that increase to 10 percent
16 to 20 inches, very pale brown, indurated calcium carbonate

Underlying material:
20 to 80 inches, very pale brown gravelly loam

Important soil properties—

Drainage: Well drained
Runoff: Medium
Permeability: Moderately slow
Available water capacity: Low
Hazard of wind erosion: Moderate
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Moderate

Included with this soil in mapping are small areas of Angelo, Ector, and Noelke soils. Angelo soils are very deep and are in lower areas on the landscape. Ector and Noelke soils are very gravelly and are on hillsides. The included soils make up 15 percent of the map unit.

This soil is in rangeland. Major concerns are suppressing mesquite and maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This Mereta soil is suitable for cropland, although it is shallow and droughty. Irrigation produces best results; however, adequate sources of irrigation water are not available at present.

This soil is poorly suited to most urban and engineering uses. An indurated calcium carbonate layer at a shallow depth affects septic tank absorption fields, excavations, and impoundments. A moderate potential for shrinking and swelling is a limitation for foundations. The risk of corrosion of underground, uncoated steel pipe is high.

This Mereta soil is in capability subclass 3e nonirrigated, 3e irrigated, and in the Shallow range site.

NKC—Noelke very gravelly silty clay loam, 0 to 5 percent slopes

This soil is shallow or very shallow to indurated calcium carbonate and to hard limestone bedrock. It is on nearly level to gently sloping hillsides in the southeast part of Reagan County. Areas are irregular in shape and range from 10 to 400 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 5 inches, grayish brown very gravelly silty clay loam, 40 percent limestone and calcium carbonate fragments 0.125 to 5.0 inches across

Subsurface layer:
5 to 12 inches, brown very gravelly silty clay loam, 60 percent calcium carbonate concretions 0.125 to 10.0 inches across

Subsoil:
12 to 15 inches, pinkish white, indurated calcium carbonate

Underlying material:
15 to 80 inches, very pale brown fractured limestone bedrock

Important soil properties—

Drainage: Well drained
Runoff: Low to high
Permeability: Moderate
Available water capacity: Very low
Hazard of wind erosion: Slight
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Ector and Mereta soils. Ector soils have more carbonates than the Noelke soil and typically are on higher and steeper slopes. Mereta soils are deeper, more clayey, and on less sloping plains than the

Noelke soil. The included soils make up 20 percent of the map unit.

This soil is used as rangeland. A major concern is maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This soil is not suitable for cropland because of the shallow or very shallow depth.

This soil has severe limitations for most urban and engineering uses. Hard limestone at a depth of less than 20 inches affects excavations, septic tank absorption fields, impoundments, and foundations.

This Noelke soil is in capability subclass 7s and in the Limestone Hill range site.

OW—Oil-waste land

Areas of Oil-waste land are bare of vegetation and are actively eroding. Salt water from oil wells, and to a much lesser extent, oil, killed the vegetation (fig. 8). The amount of salinity is moderate or strong. In some places more than 4 feet of soil material has been washed away by sheet erosion. Wind erosion has been a problem in other areas. Some of the smaller areas and areas having more recent saltwater spills are slightly eroded. Slopes range from 0 to 3 percent.

Included with Oil-waste land in mapping are many very small areas of soils that have less salt and oil spill damage. These areas, which support various amounts of vegetation, are mostly Reagan loam. The included soils make up about 20 percent of the map unit.

This land is not suited for agricultural purposes in its present condition. About one-half of the areas can be readily reclaimed. The rest can be reclaimed with much greater effort, expense, and time. Reclamation measures include applying gypsum, leaching salts with freshwater, and planting salt-tolerant plants. The gypsum improves the permeability and helps release the sodium salts for leaching. The underlying material of Hollomex and Reeves soils is a source of gypsum in the survey area. Downslope soils and water supplies can be damaged if water is allowed to move across the surface as runoff during the flushing or leaching process. Because of the very slow infiltration rate of these soils, the water used in leaching should be impounded on the surface.

This map unit is in capability class 8s. A range site has not been assigned because this map unit supports little or no vegetation.

PWC—Penwell fine sand, undulating

This very deep sandy soil is in one area on the west side of Upton County. It has a dune topography. Side slopes of the dunes mainly range from 1 to 8 percent.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 15 inches, light brown fine sand

Underlying material:
15 to 80 inches, reddish yellow fine sand

Important soil properties—

Drainage: Excessively drained
Runoff: Negligible to low
Permeability: Rapid
Available water capacity: Very low
Hazard of wind erosion: Severe
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Pyote soils, Penwell soils that have slopes ranging to 15 percent, and bare blowouts. Pyote soils have more clay in the subsoil than the Penwell soil and typically are lower on the landscape. Blowouts are areas of bare soil created by wind erosion. The included soils make up about 10 percent of the map unit.

This soil is used as rangeland. Forage production is medium. The typical woody vegetation is shinnery oak. A major concern is maintaining an adequate plant cover to prevent wind erosion, to reduce soil temperature, and to reduce evaporation. Blowouts occur when the soil is left without plant cover. Blowouts are bare, shallow pits that become deeper as erosion progresses. They are accompanied by dune formation in the downwind areas. Many good forage plants grow on this Penwell soil because of lower evaporation rates. The rainfall percolates rapidly into the underlying material and is protected from rapid evaporation. Most of this deeply stored water is available for deep-rooted range plants.

This soil is not suitable for cropland because of the severe hazard of wind erosion. The continuous standing plant cover needed to prevent soil blowing is difficult to maintain even with irrigation.

This soil is poorly suited to most urban and engineering uses. Sidewalls of excavations are unstable and cave readily. Impoundments do not hold water. Septic tank absorption fields can pollute nearby underground water supplies. The loose sand must be

Figure 8.—An area of Oil-waste land. Exposure of the roots on these mesquite stumps indicates erosion has occurred.

adequately confined before construction of foundations is possible.

This Penwell soil is in capability subclass 7e and in the Sandhills range site.

PYB—Pyote loamy fine sand, 0 to 3 percent slopes

This very deep, nearly level to gently sloping soil is in the western part of Upton County. Areas are irregular in shape and range from 20 to 300 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 24 inches, brown loamy fine sand

Subsoil:
24 to 42 inches, strong brown fine sandy loam
42 to 60 inches, yellowish red fine sandy loam
60 to 80 inches, reddish yellow loamy fine sand

Important soil properties—

Drainage: Well drained
Runoff: Negligible
Permeability: Moderately rapid
Available water capacity: Low
Hazard of wind erosion: Severe
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of

Penwell and Wickett soils. Also included are small areas of soils that are in positions on the landscape similar to those of the Pyote soil and that have more clay in the subsoil than the Pyote soil. Penwell soils are very deep fine sand and are in higher positions than the Pyote soil. Wickett soils have an indurated calcium carbonate layer at a depth of about 33 inches. They are in positions on the landscape similar to those of the Pyote soil. The included soils make up about 33 percent of the map unit.

This soil is used as rangeland. A major concern is maintaining an adequate plant cover to prevent wind erosion, to reduce soil temperature, and to reduce evaporation. Blowouts occur if the soil is left without plant cover. These blowouts are bare, shallow pits that become deeper as the erosion progresses. They are accompanied by dune formation in the downwind areas. Many good forage plants grow on this soil because the evaporation rates are lower. The rainfall percolates rapidly into the subsoil and is protected from rapid evaporation. Most of this deeply stored water is available for plant growth.

This soil is not suitable for nonirrigated cropland because of the hazard of wind erosion and droughtiness. It is suited to irrigated cropland; however, no known sources of irrigation water are available.

This soil is suited to most urban and engineering uses. It makes strong building foundations and firm subgrades for roads. Septic tank absorption fields work well in this soil. Sidewalls of excavations are unstable and cave readily. Impoundments are subject to seepage.

This Pyote soil is in capability subclass 6e nonirrigated, 4e irrigated, and in the Loamy Sand range site.

RaA—Reagan loam, 0 to 1 percent slopes

This very deep and nearly level soil formed in calcareous loamy materials that are a mixture of water and wind deposits. It is on smooth, broad plains and broad valley floors. This extensive map unit makes up about 43 percent of the survey area and is mostly in the northern part. Individual areas are very large.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 8 inches, brown loam

Subsoil:
8 to 30 inches, light brown clay loam
30 to 50 inches, reddish yellow clay loam, about 35 percent fine concretions and masses of calcium carbonate
50 to 80 inches, reddish yellow clay loam, about 5 percent fine masses of calcium carbonate

Important soil properties—

Drainage: Well drained
Runoff: Negligible
Permeability: Moderate
Available water capacity: Moderate
Hazard of wind erosion: Moderate
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: Moderate

Included with this soil in mapping are small areas of Angelo and Conger soils. Angelo soils are darker in color and more clayey than the Reagan soil. They are in slightly lower positions on the landscape and receive more water than the Reagan soil. Conger soils are shallow to indurated calcium carbonate and are in higher landscape positions. The included soils make up about 5 percent of the map unit.

This soil is used as rangeland. Major concerns are suppressing mesquite and maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

Most of the cropland in the survey area is on this soil. Much more land could be cultivated if more irrigation water were available. A properly designed irrigation system and proper application of irrigation water are necessary to conserve the limited water supply. A wide variety of crops can be grown on this soil; however, the small water supplies limit crop choices to the most drought resistant. Cotton is the most common crop grown (fig. 9). As the water supply diminishes, farmers may choose to irrigate only small acreages of higher value crops, such as fruits, vegetables, or spices. Applications of fertilizer are needed for optimum yields. Crop residue, left on or near the soil surface, helps to protect the soil from wind erosion and helps to conserve moisture.

This soil is suitable for most urban and engineering uses. The potential for shrinking and swelling is moderate with changes in moisture. This soil is corrosive to underground, uncoated steel pipe. Seepage is a hazard where the soil is used for impoundments. Septic tank absorption fields work well in this soil.

This Reagan soil is in capability subclass

Figure 9.—An area of irrigated cotton on Reagan loam, 0 to 1 percent slopes. This soil is well suited to growing crops where irrigation water is available.

6c non-irrigated, 1 irrigated, and in the Loamy range site.

RaB—Reagan loam, 1 to 3 percent slopes

This very deep, very gently sloping soil is on broad valley floors and long footslopes of steeper hills. Areas are mostly large, ranging from 10 to many thousand acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 8 inches, pale brown loam

Subsoil:
8 to 26 inches, light yellowish brown loam
26 to 53 inches, pinkish white loam, 25 percent fine concretions, 25 percent soft powdery calcium carbonate
53 to 80 inches, pink loam, 10 percent powdery calcium carbonate

Important soil properties—

Drainage: Well drained
Runoff: Very low
Permeability: Moderate
Available water capacity: Moderate
Hazard of wind erosion: Moderate
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: Moderate

Included with this soil in mapping are small areas of Angelo, Conger, Tencee, and Upton soils. Angelo soils are darker in color and more clayey than the Reagan soil. They are in slightly lower areas where they receive more water. Conger soils are shallow to indurated calcium carbonate. Tencee and Upton soils are shallow and are gravelly or very gravelly. Conger, Tencee, and Upton soils are in higher areas on the landscape. The included soils make up about 5 percent of the map unit.

This soil is used as rangeland. Major concerns

are suppressing mesquite and maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This soil is suitable for irrigated cropland; however, the hazard of erosion and the difficulty of getting irrigation water applied uniformly make this soil less desirable than the nearly level Reagan soil. A wide variety of crops can be grown on this soil; however, low irrigation water supplies limit crop choices to the most drought resistant. As the water supply diminishes, farmers may choose to irrigate only small acreages of higher value crops, such as fruits, vegetables, or spices. Applications of fertilizer are needed for optimum yields. Crop residue left on or near the soil surface helps to protect the soil from water and wind erosion and conserves moisture by reducing evaporation. A properly designed irrigation system and proper application of irrigation water are necessary to conserve the very limited water supply.

This soil is suitable for most urban and engineering uses. The potential for shrinking and swelling is moderate with changes in moisture. The soil is corrosive to underground, uncoated steel pipe. Seepage is a hazard when the soil is used for impoundments. Septic tank absorption fields work well in this soil.

This Reagan soil is in capability subclass 6e nonirrigated, 2e irrigated, and in the Loamy range site.

REB—Reeves loam, 0 to 5 percent slopes

This very deep soil has gypsiferous materials at a depth of 20 to 40 inches. It is nearly level to gently undulating. It is around intermittent lakes, and the widest areas are on the north and northeast sides of the lakes. Areas are rounded and range from 10 to 300 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 16 inches, light gray loam

Subsoil:
16 to 22 inches, very pale brown loam
22 to 80 inches, white clay loam with powdery gypsum

Important soil properties—

Drainage: Well drained
Runoff: Negligible to low
Permeability: Moderate
Available water capacity: Moderate
Hazard of wind erosion: Moderate
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Moderate

Included with this soil in mapping are small areas of Hollomex and Reagan soils. Hollomex soils are not as deep to gypsiferous materials as the Reeves soil, and typically are in higher positions on the landscape. Reagan soils are underlain by loamy material and are on broad plains in positions similar to those of the Reeves soil. The included soils make up 15 percent of the map unit.

This soil is used mainly as rangeland. A major concern is maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed.

This soil is poorly suited to cropland because of the lack of irrigation water in most areas and the difficulty in applying irrigation water evenly in sloping areas.

This soil is suitable for most urban and engineering uses. The potential for shrinking and swelling is moderate; thus, foundations of roads and buildings must be properly designed. The risk of corrosion of underground, uncoated steel pipe is high. The risk of seepage is a severe limitation for impoundments. This soil has low strength when used as roadfill.

This Reeves soil is in capability subclass 7e nonirrigated, 3e irrigated, and in the Loamy range site.

Ro—Rioconcho silty clay loam, occasionally flooded

This very deep, nearly level alluvial soil is on flood plains of large streams in the eastern part of the survey area. It is occasionally flooded by stream overflow and receives extra water from adjacent, higher-lying soils. The chance of flooding for a duration of less than 2 days is 5 to 50 percent each year. Slopes are less than 1 percent. Areas are long and narrow and range in size from 100 to several thousand acres.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 16 inches, dark grayish brown silty clay loam

Subsurface layer:
16 to 30 inches, brown silty clay loam

Subsoil:
30 to 80 inches, light brown silty clay

Important soil properties—

Drainage: Moderately well drained
Runoff: Low
Permeability: Slow
Available water capacity: High
Hazard of wind erosion: Moderate
Hazard of water erosion: Slight
Hazard of flooding: Occasional, for very brief duration
Shrink-swell potential: High

Included with this soil in mapping are stream channels and small areas of Angelo soils. The stream channels contain recent flood deposits and are variable in gravel, sand, silt, and clay content and in slope. Angelo soils are above normal overflow. The included soils make up 15 percent of the map unit.

This soil is used as rangeland. Major concerns are suppressing mesquite and maintaining an adequate plant cover to reduce evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed. Most areas receive and absorb from adjacent surrounding slopes some runoff, which partly reduces the effects of the low amount of rainfall.

Crops could be grown on this soil if irrigated. At present, no sources of irrigation water are available.

This soil is not suited for most urban and engineering uses. Homes and other permanent structures should not be built on this soil because of the hazard of flooding.

This Rioconcho soil is in capability subclass 2w nonirrigated, 2w irrigated, and in the Loamy Bottomland range site.

SAC—Sanderson very gravelly loam, 1 to 8 percent slopes

This very deep, gently sloping or moderately sloping soil is on footslopes at the bases of steeper limestone hills. Areas are irregular in shape and range from 10 to 1,500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 12 inches, pale brown very gravelly loam, 40 percent rounded limestone gravel

Subsoil:
12 to 53 inches, light yellowish brown very gravelly loam, 40 percent rounded limestone gravel

Underlying material:
53 to 80 inches, very pale brown very gravelly loam, 50 percent rounded limestone gravel

Important soil properties—

Drainage: Well drained
Runoff: Very low to medium
Permeability: Moderate
Available water capacity: Low
Hazard of wind erosion: Slight
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Reagan and Upton soils, soils on footslopes that have a gravel content of less than 35 percent, and a few steep-sided gullies. Reagan soils are loamy and typically are less sloping than the Sanderson soil. They are in lower areas on the landscape. Upton soils are shallow to an indurated calcium carbonate layer, and in some places, are on footslopes in positions similar to those of the Sanderson soil. The included soils make up about 33 percent of the map unit.

This soil is used as rangeland. Major concerns are suppressing mesquite and maintaining an adequate plant cover to reduce runoff, erosion, and evaporation. Timely deferments of grazing are needed to enable forage plants to stay vigorous and to produce seed. The few steep-sided gullies in these areas should be blocked and the runoff diverted to safe drainageways, where the plant cover can be given extra protection from grazing animals.

This soil is not suitable for cropland. It is too steep and too gravelly.

This soil is suitable for most urban and engineering uses. Seepage is a problem when the soil is used for impoundments. Septic tank absorption fields work well in this soil.

This Sanderson soil is in capability subclass 6s and in the Gravelly range site.

TEC—Tencee and Upton soils, 1 to 8 percent slopes

These soils are shallow to indurated calcium carbonate. They are mainly on an undulating landscape that has a complex drainage pattern, but are also on footslopes. Most areas of these soils are in Upton County. Areas are irregular in shape and range from 10 to 1,000 acres in size.

Typically, this map unit is 60 percent Tencee soil, 25 percent Upton soil, and 15 percent other soils. Some areas are mostly Tencee soil. A few areas are dominantly Upton soil. These soils are not uniform and do not occur in a regular pattern.

The typical sequence, depth, and composition of the layers of the Tencee soil are:

Surface layer:
0 to 2 inches, pale brown very gravelly loam, 55 percent gravel

Subsurface layer:
2 to 11 inches, light yellowish brown very gravelly loam, 55 percent gravel

Subsoil:
11 to 24 inches, pinkish white, indurated calcium carbonate
24 to 34 inches, very pale brown very gravelly loam, 20 percent calcium carbonate concretions

Underlying material:
34 to 80 inches, pinkish white very gravelly loam

Important soil properties of the Tencee soil—

Drainage: Well drained
Runoff: Medium to very high
Permeability: Moderate in the upper part, very slow in the indurated layer
Available water capacity: Very low
Hazard of wind erosion: Slight
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

The typical sequence, depth, and composition of the layers of the Upton soil are:

Surface layer:
0 to 4 inches, pale brown gravelly loam, 15 percent limestone fragments

Subsoil:
4 to 14 inches, pale brown gravelly loam, 30 percent calcium carbonate and limestone fragments
14 to 30 inches, white, indurated calcium carbonate
30 to 80 inches, white gravelly loam, 20 percent limestone fragments

Important soil properties of the Upton soil—

Drainage: Well drained
Runoff: Low to very high
Permeability: Moderate
Available water capacity: Very low
Hazard of wind erosion: Slight
Hazard of water erosion: Moderate
Hazard of flooding: None
Shrink-swell potential: Low

Included with these soils in mapping are small areas of Conger, Lozier, Reagan, and Sanderson soils, which together make up 15 percent of the map unit. Conger soils are in positions on the landscape similar to those of the Tencee and Upton soils and have less carbonates than those soils. Lozier soils are underlain by limestone bedrock at a depth of less than 20 inches and are on slopes on higher lying positions. Reagan soils are very deep loam. Sanderson soils are very deep and very gravelly. Reagan and Sanderson soils are in lower positions on the landscape.

The Tencee and Upton soils are used as rangeland. Major concerns are reducing runoff and maintaining an adequate plant cover to reduce water erosion and evaporation. Timely deferments of grazing are needed so that plants can stay vigorous and produce seeds.

These soils are not suited to growing crops because of the very low available water capacity and shallow rooting depth.

These soils have severe limitations for most urban and engineering uses. A layer of indurated calcium carbonate at a shallow depth affects excavations, septic tank absorption fields, foundations, and impoundments. It also causes a hazard of corrosion of underground, uncoated steel pipe. Removing this layer can make these soils more suitable for urban and engineering uses.

This map unit is in capability subclass 7s; the Tencee and Upton soils are in the Very Shallow range site.

TOA—Tobosa clay, 0 to 1 percent slopes, depressional

This very deep, nearly level soil is on the floor of intermittent lakes that are 2 to 20 feet lower than the surrounding plains (fig. 10). Slopes are concave and less than 1 percent. Some areas have pits about 25 feet apart, 6 to 10 feet wide, and 10 inches deep.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 16 inches, grayish brown clay

Subsoil:
16 to 40 inches, brown clay

Underlying material:
40 to 80 inches, pale brown clay

Important soil properties—

Drainage: Well drained
Runoff: Negligible
Permeability: Very slow, but rapid when dry weather cracks are present
Available water capacity: High
Hazard of wind erosion: Moderate

Figure 10.—An area of Tobosa clay, 0 to 1 percent slopes, depressional. The small pits in the surface are caused by the high shrink-swell characteristics of this soil.

Hazard of water erosion: Slight
Hazard of flooding: None; water ponds once every 2 to 10 years for a duration of 1 to 12 weeks
Shrink-swell potential: Very high

Included with this soil in mapping are intermittent lakes where the soils are somewhat poorly drained. In these areas, water is on the surface for a longer time than normal and the soils are lighter in color and are grayer than the Tobosa soil. The included soils make up about 10 percent of the map unit. Also included are soils where loose stones and cobbles on the surface are 2 to 50 feet apart. The included stony soils make up 25 percent of the map unit.

Most areas of this soil are used as rangeland. In some years, range forage is benefited by runoff from higher-lying soils. If water remains for more than 3 days, however, most plants will drown. Many of the plants are annuals that can grow rapidly and produce seed quickly. The annuals commonly include bitterweed, which causes poisoning in sheep.

A small acreage of the Tobosa soil is cultivated in the northern part of Reagan County. Ponding of water can be prevented on this soil by placing level terraces on the surrounding land. This soil is difficult to till. If it is tilled when wet, the clay forms extremely hard clods. If the soil is tilled when dry, more powerful equipment could be required. When irrigated, a properly designed irrigation system and proper application of irrigation water are necessary to conserve the limited water supply.

The Tobosa soil is not suited to most urban and engineering uses. Because of the high content of clay, which causes shrinking and swelling with changes in moisture, extremely strong foundations for buildings and adequate subgrades for roads are required. The risk of corrosion of uncoated steel is high. Excavations are difficult and dangerous. Vertical cuts can collapse

suddenly without warning. Septic tank absorption fields must be very large to function properly because of the very slow permeability. When ponding occurs on this soil, septic tank absorption fields will fail entirely. The ponding also adversely affects sewage lagoons, sanitary landfills, roads, and buildings.

This Tobosa soil is in capability subclass 3s nonirrigated, 3s irrigated, and in the Clay Flat range site.

WKB—Wickett loamy fine sand, 0 to 3 percent slopes

This soil is moderately deep to indurated calcium carbonate. It is nearly level to gently sloping and is in the western part of Upton County. Areas are irregular in shape and range from 20 to 300 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 16 inches, strong brown loamy fine sand

Subsoil:
16 to 24 inches, strong brown fine sandy loam
24 to 33 inches, yellowish red fine sandy loam
33 to 49 inches, pinkish white, indurated calcium carbonate

Underlying material:
49 to 80 inches, pinkish white gravelly loam, 15 percent calcium carbonate concretions

Important soil properties—

Drainage: Well drained
Runoff: Low or medium
Permeability: Moderately rapid
Available water capacity: Low
Hazard of wind erosion: Severe
Hazard of water erosion: Slight
Hazard of flooding: None
Shrink-swell potential: Low

Included with this soil in mapping are small areas of Blakeney and Pyote soils. Also included are soils that are in positions on the landscape similar to those of the Wickett soil and that have an indurated calcium carbonate layer below a depth of 40 inches. Blakeney soils have a loamy surface layer, are less than 20 inches deep over indurated calcium carbonate, and are in positions on the landscape similar to those of the Wickett soil. Pyote soils do not have an indurated calcium carbonate layer and typically are at higher elevations than the Wickett soil. The included soils make up about 20 percent of the map unit.

This soil is used as rangeland. Major concerns are reducing wind erosion and suppressing mesquite. Local shifting of soils is evident in most areas by low dunes at the base of mesquite trees. A good cover is needed to prevent wind erosion and to reduce evaporation. Timely deferments of grazing are needed to enable plants to stay vigorous and to produce seed.

This soil is not suitable for nonirrigated cropland because of the hazard of wind erosion and droughtiness. At present, no known sources of irrigation water are available.

Wickett soils have some limitations for urban and engineering uses. The indurated calcium carbonate layer is very difficult to excavate; however, it makes strong foundations for low buildings. When this soil is used as septic tank absorption fields, the indurated calcium carbonate layer must be removed. The underlying material, below the indurated layer, is corrosive to underground, uncoated steel pipe, and when used for impoundments, is subject to seepage.

This Wickett soil is in capability subclass 6e nonirrigated, 4e irrigated, and in the Loamy Sand range site.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pasture land, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 5 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

Soils that are in areas of low rainfall, such as Reagan and Upton Counties, qualify as prime farmland only if this limitation is overcome by irrigation. In the list at the end of this section this qualification is shown in parentheses after the map unit name. Onsite evaluation is necessary to determine if an irrigation system is installed that is adequate to overcome this limitation.

This list does not constitute a recommendation for a particular land use. On some soils included in the list, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading “Detailed Soil Map Units.”

The following map units that meet the requirements for prime farmland are:

AnA Angelo silty clay loam, 0 to 1 percent slopes (where irrigated)
AnB Angelo silty clay loam, 1 to 3 percent slopes (where irrigated)
CrB Conger-Reagan association, 0 to 3 percent slopes (where irrigated)
Ir Iraan silty clay loam, occasionally flooded (where irrigated)
MeB Mereta clay loam, 1 to 3 percent slopes (where irrigated)
RaA Reagan loam, 0 to 1 percent slopes (where irrigated)
RaB Reagan loam, 1 to 3 percent slopes (where irrigated)
Ro Rioconcho silty clay loam, occasionally flooded (where irrigated)
TOA Tobosa clay, 0 to 1 percent slopes, depressional (where irrigated)

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for rangeland; for crops; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Rangeland

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

About 1,505,000 acres, or 97 percent of Reagan and Upton Counties, is rangeland. In the survey area in 1986, there were an estimated 13,000 cows and calves, 41,000 ewes and lambs, and 3,500 goats. Wool production was 341,000 pounds. Ranches are large, averaging about 7,000 acres *(6)*. Mule deer, white-tailed deer, and pronghorn antelope also use this rangeland. The estimates of deer numbers varies from 3,000 to 8,000, depending upon variation in rainfall, evaporation rates, and increase in woody plants that are low in forage production.

The flood plain and valley soils along Centralia Draw and its tributaries, and along Rankin Draw provide the most productive rangeland in the survey area. These soils are mainly Iraan, Reagan, and Rioconcho soils and are in map unit 5 on the General Soil Map in the back of this publication. The soils are very deep, very fertile, and can store large amounts of water. They benefit from extra water from flooding or from runoff from higher slopes. Most of the forage is produced in narrow drainageways. The soils on flood plains are Iraan and Rioconcho soils. The soils in the adjacent, nearly level valley above overflow are Angelo and Reagan soils. Cattle, sheep, and deer do well in these areas. Texas needlegrass, Canada wildrye, and several forbs are green in winter and high in protein. They can supply as much as 20 percent of the annual forage. They provide very important forage in January and February. Rescuegrass is abundant in years of above average winter moisture. Although it is a short-lived grass, it is also green in January and February, and in some years, supplies a significant amount of high protein forage. The flood plain and valley soils produce the best forage; therefore, keeping livestock from overgrazing is difficult.

Some of the more sandy soils in the western part of Upton County also produce abundant forage. These soils are in map unit 7 on the General Soil Map. The major soils in these areas are Kinco, Penwell, Pyote, and Wickett soils. Tall grasses grow there although these soils are in the driest part of the survey area. Sands, loamy sands, and sandy loams take up water readily, but do not hold much water per foot of depth;

consequently, rains go deeply into the subsoil, escaping rapid evaporation. Plants use most of the rainfall. A higher percentage of moisture is lost to evaporation in the more clayey soils.

Angelo, Noelke, and Mereta soils are in General Soil Map Unit 6, which is in the southeast part of Reagan County. These soils range from shallow to very deep and most are nearly level. Forage production is good because these soils receive more rainfall than soils in other areas. However, bitterweed is more common in areas of these soils. In years when moisture is above average in fall and winter, bitterweed is abundant. Hungry sheep eat bitterweed and sicken or die. Cattle generally avoid the poisonous weed.

In some years, forage production is good on the soils in General Soil Map Units 3 and 4. The major soils are Ector, Lozier, Tencee, and Upton soils. They are shallow or very shallow to hard limestone. They are gently sloping to very steep, making runoff rates medium or high. Large amounts of broken limestone or indurated calcium carbonate are on the surface. These fragments shed rainfall and allow the rain to concentrate in the soil around the fragments; therefore, even small showers can wet the entire soil surface. Green forage growing on the stony and gravelly limestone hills is common, while none grows in the valley where the soils are deeper but where rainfall evaporates in 1 or 2 days.

About 73 percent of the survey area is in General Soil Map Units 1, 2, and 8. Most of the rainfall in these areas soaks into the ground because the slopes are nearly level to gently sloping. Most of the runoff is to intermittent lakes. The major soils are Angelo, Conger, Reagan, and Tobosa soils. They are deep enough and fertile; however, the low and erratic rainfall and high evaporation rate combine to keep forage production down.

Vegetation has varied many times during the past 130 years. Using barbed wire fencing, increasing the water supply with wells and windmills, reducing prairie fires, and changing the kinds of grazing animals have been major factors influencing the amount and kind of vegetation.

Bison, prairie dogs, pronghorns, deer, and rabbits once grazed these areas. The bison are gone, the prairie dogs are much reduced, and the pronghorns declined because of fencing. Sheep, cattle, and goats have replaced them. Because each group of animals has plant preferences, some of the preferred plants are grazed more often and not allowed to reproduce.

Once, the bison migrated north in spring and summer. Only mule deer and pronghorns stayed continuously. Before windmills were used, the only available water was the Pecos River to the west or runoff water in very temporary impoundments. Presently, water sources are 1 to 2 miles apart. Because of the availability of water and the bison migration, grazing evolved from sporadic to continuous. Overgrazing prevented seed production of the best forage plants and favored spiny or poisonous plants, which can produce seed when grazing animals are continually present. Prairie fires were common before fences were used; however, they were fought vigorously after fencing to save posts and livestock. Fires tend to favor bluestem grasses and reduce threeawns and cacti. Woody plants that sprout from the stumps are not killed by prairie fires. Seed production and seedling survival, however, are reduced after many years and many fires.

These factors do not totally explain the recent increase in mesquite. One theory is that bison had a role in suppressing it. Without wintertime protein supplements available to livestock, bison may have browsed the mesquite seedlings and kept them from reaching seed-bearing stage. Also, prairie dogs help maintain the prairie by girdling many of the woody plants in their territory.

Mesquite has increased tremendously in the survey area and is now abundant on all the deeper soils. Redberry juniper has increased on the limestone hills and is invading some deep valley soils. Tarbush has increased in density on the Reagan soils and creosotebush has increased on the shallow and gravelly soils. As late as 1920, reports were that a very small amount of mesquite was on the nearly level Reagan soils in the northern part of both Reagan and Upton Counties. In the 1930s, ranchers were chasing coyotes north of Stiles *(5)*. This would be impossible today because of the brush. In the past, cleared land was the most valuable because removing woody plants increases the water available for livestock forage. Now, scenic, recreational, and aesthetic values are important in determining land prices.

Plant growth is optimum during April and May and again during September and October, when rainfall and temperatures are most favorable. Forage produced in the fall is most important because it provides most of the forage used for winter grazing. If livestock is not sold promptly when the soil is dry at the beginning of either of the growth periods, severe overgrazing can occur, killing perennial plants.

Rainfall is very erratic over the survey area. Much of it occurs in the form of thunderstorms. Evaporation rates are high because winds are high and humidity is low. About 7 feet of water evaporates from a lake in a year.

All wildlife depends on woody plants for much of their food and cover. Woody plant removal is more

selective and is done in patches and strips, or with prairie fires. Brush removal with chemicals and machines is very expensive. Much of the rangeland has been cleared three times since 1930, but brush has always regrown from sprouts and released seedlings. The main method of mesquite removal is prairie fires, although fires do not kill much mesquite because older trees resprout from the stumps. Some seedlings are killed and after many fires, the original prairie vegetation is gradually restored.

Grass tops and grass roots grow most rapidly when there is a large amount of green foliage. Thus, half the annual plant production is better left ungrazed, achieving maximum or near maximum production and keeping a plant cover that preserves all the plant, soil, and water resources. Plant cover, either dead or living, increases water intake, prevents wind erosion, and prevents water erosion by slowing runoff. It also reduces evaporation by shading the soil. Deferred or intermittent grazing allows plants to reproduce. Reseeding native forbs and native grasses is needed on former cropland or on severely overgrazed land.

Soil erosion by runoff or by soil blowing is not a problem on rangeland that has a good cover of plants; however, wind and water erosion are a hazard on unsurfaced ranch roads. The plant cover is destroyed by ranch vehicles patrolling the fences. It takes little traffic to destroy the cover in arid rangeland. Upon drying, silty and loamy soils quickly turn to dust and clouds of dust trail behind each passing vehicle. A cover of gravel can prevent this kind of wind erosion. Gravelly, calcareous loamy materials are widely available in areas of Reagan, Conger, Mereta, Upton, and Tencee soils. These materials are excellent road surfacing material.

Gullies 1 to 3 feet deep are common adjacent to property line fences on slopes. In some places, gullies are on each side of the fence. Gullies along fence lines are difficult to prevent; however, short runoff diversion ridges can be built so runoff is turned away from the road to a good grass cover.

Table 5 shows, for each soil, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. An explanation of the column headings in Table 5 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Range sites

In the following paragraphs, the plant community is described for each of the 15 range sites in the survey area.

Clay Flat range site. The Tobosa soil in map unit TOA is in this range site. Shallow lakes form after heavy rainfall, drowning most of the plants. When rainfall is light, this range site benefits from runoff from higher-lying soils. The length of time the soil is inundated determines the kinds of plants that can grow there. In years of frequent rainfall, most plants are

annuals, such as little barley and filaree. They germinate and grow to maturity in a short time. A perennial grass that can grow on this site is buffalograss. The plant parts that survive being inundated can spread to bare ground by runners. Buffalograss, vine-mesquite, white tridens, and some sedges are preferred by livestock. They are the first to be removed by heavy grazing. These plants are replaced by less palatable annuals.

Clay Loam range site. The Angelo soil in map units AnA and AnB are in this site. The climax vegetation is a prairie consisting of 90 percent perennial grasses and 10 percent forbs and woody plants.

Such plants as sideoats grama, cane bluestem, and vine-mesquite are preferred by livestock. They are the first to be removed by heavy grazing, and are replaced by such plants as curlymesquite, buffalograss, Texas needlegrass, tobosa, fall witchgrass, and slim tridens. Under long, continued overgrazing, the site is invaded by bitterweed, mesquite, lotebush, threeawns, cacti, and annual grasses and other annual forbs.

Draw range site. The Iraan soil in map unit Ir is in this range site. The climax vegetation is a mid grass prairie consisting of 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

Sideoats grama, cane bluestem, vine-mesquite, and Arizona cottontop are preferred by livestock. They are the first to be removed by heavy grazing. These plants are replaced by buffalograss, curlymesquite, tobosa, and green sprangletop. If heavy grazing continues, the plant community is invaded by threeawn grasses, annual plants, cacti, and thorny plants.

Gravelly range site. The Sanderson soil in map unit SAC is in this range site. The climax vegetation is a prairie consisting of 10 percent perennial forbs, 15 percent woody plants, and 75 percent grasses.

Rough menodora, black grama, bush muhly, blue grama, sideoats grama, and plains bristlegrass are preferred by livestock. They are the first to be removed by heavy grazing. These plants are replaced by slim tridens, Wright threeawn, and sand dropseed. Under continued heavy grazing, the site is invaded by mesquite, creosotebush, fluffgrass, various threeawns, annuals, and cacti.

Gyp range site. The Hollomex soil in map unit HMC is in this range site. The climax vegetation is a prairie consisting of 15 percent forbs, 5 percent shrubs, and 80 percent perennial grasses.

Such plants as the primroses, mormon tea, black grama, and buffalograss are preferred by livestock. They are the first to be removed by heavy grazing. These grasses are replaced by burrograss, sand dropseed, threeawns, and hairy tridens. Under continued overgrazing the site is invaded by mesquite, creosotebush, tarbush, lotebush, and annual forbs and grasses.

Limestone Hill range site. The Ector soil in map unit ECC, the Lozier soil in map unit LZD, and the Noelke soil in map unit NKC are in this range site. The climax vegetation is a prairie consisting of 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

Morman tea, primroses, bush sunflower, Engelmann daisy, sideoats grama, Neally wild buckwheat, cane bluestem, black grama, and Louisiana sagewort are preferred by livestock. They are the first to be removed by heavy grazing. These plants are replaced by green sprangletop, buffalograss, curlymesquite, slim tridens, fall witchgrass, hairy tridens, Texas needlegrass, and threeawns. Under continued heavy grazing, the site is invaded by redberry juniper, mesquite, lotebush, cacti, and annuals, such as plantain and filaree.

Loamy range site. The Reagan soil in map units RaA, RaB, and CrB and the Reeves soil in map unit REB are in this range site (fig. 11). The climax vegetation is an open, short grass prairie consisting of 5 percent forbs, 5 percent woody plants, and 90 percent perennial grasses.

Such plants as buffalograss, sideoats grama, cane bluestem, vine-mesquite, black grama, plains bristlegrass, primroses, and morman tea are preferred by livestock. They are the first to be removed by heavy grazing. These plants are replaced by burrograss, sand dropseed, fall witchgrass, scarlet globemallow, mesa muhly, slim tridens, and tarbush. Under continued heavy grazing the site is invaded by more tarbush, mesquite, hairy tridens, red grama, crotons, broomweeds, coldenia, evax, desert holly, plantain, bladderpod, filaree, and cacti.

Loamy Bottomland range site. The Rioconcho soil in map unit Ro is in this range site. The climax vegetation is 5 percent forbs, 5 percent woody plants, and 90 percent perennial grasses.

Such plants as cane bluestem, sideoats grama, Canada wildrye, vine-mesquite, plains lovegrass, plains bristlegrass, Texas needlegrass, virginsbower, and Indian mallow are preferred by livestock. They are the first to be removed by heavy grazing. These plants are replaced by buffalograss, curlymesquite, sand dropseed, tobosa, and threeawns. Under continued heavy grazing, the site is invaded by mesquite, hairy tridens, and annuals, such as sunflowers, rescue grass, thistle, bitterweed, nightshade, and filaree.

Loamy Sand range site. The Pyote soil in map unit PYB and the Wickett soil in map unit WKB are in this range site. The climax vegetation is mostly tall and mid grasses and scattered shrubs. It consists of about 10

Figure 11.—These cattle are grazing an area of Reeves loam, 0 to 5 percent slopes, which is in the Loamy range site.

percent forbs, 10 percent woody plants, and 80 percent perennial grasses.

Such plants as cane bluestem, sand and giant dropseed, little bluestem, plains bristlegrass, Arizona cottontop, bush muhly, black grama, showy menodora, and morman tea are preferred by livestock. These plants are the first to be removed by heavy grazing. They are replaced by such plants as perennial threeawn, hooded windmillgrass, sand dropseed, fall witchgrass, catclaw, and wolfberry. Under continued heavy grazing the site is invaded by mesquite and many annuals.

Saline Lakebed range site. The Ekal soil in map unit EKA is in this range site in a lakebed that is ponded intermittently. The soil is strongly saline and only salt-tolerant plants grow there. The kinds of plants at any given time depend on how recently the soils were underwater. An estimated 35 percent of the forage species are annuals. Some of the better forage plants are grasses, such as inland saltgrass and alkali sacaton; forbs, such as alkali mallow, sea purslane, silver saltbush, and kochia; and wolfberry, a woody shrub. Under continued heavy grazing, the perennial plants are eliminated and may or may not be replaced by annual plants.

Sandhills range site. The Penwell soil in map unit PWC is in this site (fig. 12). The climax vegetation is a variety of forbs and tall and midgrasses intermixed with shinnery oak. It is 10 percent forbs, 15 percent woody plants, and 75 percent perennial grasses.

Such plants as the primroses, guara, giant dropseed, Havard panicum, sand bluestem, little bluestem, and Indiangrass are preferred by livestock. They are the first to be removed by heavy grazing. They are replaced by plants, such as sand dropseed, mesa dropseed, perennial threeawns, perennial croton, Havard oak, and sand sagebrush. Under continued heavy grazing the site is invaded by mesquite, annual forbs, and sandburs.

Sandy Loam range site. The Kinco soil in map unit KNB is in this range site. The climax vegetation is a prairie with 10 percent forbs, 5 percent woody plants, and 85 percent perennial grasses.

Such plants as black grama, plains bristlegrass, Arizona cottontop, bush muhly, sideoats grama, and blackfoot daisy are preferred by livestock. They are the first to be removed by heavy grazing, and are replaced by such plants as hooded windmillgrass, mesa dropseed, sand dropseed, and burrograss. Under continued heavy grazing the site is invaded by mesquite, tarbush, perennial broomweed, perennial croton, and many annuals, such as sandburs, filaree, and plantain.

Shallow range site. The Blakeney soil in map unit BKB; the Conger soil in map unit CrB; and the Mereta soil in map units MeA and MeB are in this range site.

The climax vegetation is a prairie consisting of 80 percent grasses, 10 percent forbs, and 10 percent shrubs.

Sideoats grama, plains bristlegrass, Arizona

Figure 12.—An area of Penwell fine sand, undulating, in the Sand Hills range site. Shinnery oak is commonly intermixed with tall and mid grasses on this site.

cottontop, cane bluestem, and black grama are preferred by livestock. They are the first to be removed by heavy grazing. These plants are replaced by buffalograss, Texas needlegrass, sand dropseed, and slim tridens. Under continued heavy grazing, this site is invaded by mesquite, threeawns, hairy tridens, red grama, and a wide variety of annual plants that include bitterweed.

Steep Rocky range site. The Ector soil in map unit ECE and the Lozier soil in map unit LZG are in this range site. The climax vegetation is 10 percent forbs, 25 percent woody plants, and 65 percent perennial grasses.

Such plants as Engelmann daisy, sideoats grama, morman tea, primroses, bush sunflower, cane bluestem, Louisiana sagewort, and Texas needlegrass are preferred by livestock. They are the first to be removed by heavy grazing. These plants are replaced by green sprangletop, slim tridens, threeawns, skeletonleaf goldeneye, and hairy grama. Under continued heavy grazing the site is invaded by redberry juniper, lotebush, cacti, catclaw, littleleaf sumac, algerita, and many annual plants.

Very Shallow range site. The Tencee and Upton soils in the TEC map unit are in this range site (fig. 13).

Figure 13.—An area of Tencee very gravelly loam in the Very Shallow range site. Gravel on the surface helps to protect the soil from wind and water erosion.

The climax vegetation is 25 percent woody plants, 20 percent forbs, and 55 percent perennial grasses.

Such plants as black grama, bush muhly, and some perennial forbs like the primroses and Engelmann daisy are preferred by livestock. They are the first to be removed by heavy grazing. They are replaced by such plants as slim tridens, burrograss, sand dropseed, mesa dropseed, perennial broomweed, perennial croton, coldenia, and paperflower. Under continued heavy grazing, the site is invaded by mesquite, creosotebush, lotebush, javelinabrush, fluffgrass, threeawns, plantain, bladderpod, and several other annuals.

Crops

General management needed for crops is suggested in this section and the system of land capability classification used by the Natural Resources Conservation Service is explained.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading “Detailed Soil Map Units.” Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

The cropland in Reagan and Upton Counties takes in about 79,500 acres. All is irrigated to some extent, and most is Reagan loam, 0 to 1 percent slopes.

About 1,290 irrigation wells are in the survey area. The average yield is 40 gallons a minute; however, the yield ranges from 25 to 90 gallons a minute. In Reagan County, the average well depth is 265 feet; in Upton County it is 320 feet. During the irrigation season the level of water drops in the wells. The

water quality is good, but well production is slowly decreasing.

By far, the most common crop is cotton. Also grown, in descending order, are grain sorghum, small grains, forage crops, and pecans.

Row irrigation is the most common means of irrigation. Row length normally is 600 feet but sometimes extends to 660 feet. Because the water supply is so limited, a common row spacing is two planted rows with the third row skipped. Most of the water is delivered from the well to the crop in underground pipes, which conserve water by reducing seepage and evaporation.

About 1,600 acres is irrigated with sprinklers. Sprinkler irrigation is less efficient in this hot and dry area. On some windy, summer days, as much as 40 percent of the water pumped is lost through evaporation before it soaks into the soil. Some sprinkler systems wet only the surface layer where evaporation rates are great. Because sprinklers also require water under pressure, pumping costs are greater than for surface irrigation.

About 340 acres is trickle or drip irrigated. Trickle irrigation is a system that supplies water in drops from plastic tubes with very little evaporation. It is used on small acreages of pecans and Christmas trees.

Irrigation usually starts in winter when all the land to be planted in spring is deeply wet. The amount of additional irrigation depends on the yield of the wells, the type of crop, the acreage planted, and amount of rainfall. The total amount of water applied for the crop year ranges from 5 to 24 inches, averaging about 14 inches. Pumping is done with submersible electric pumps. Electricity costs have increased in recent years. These costs and a diminishing water supply may some day force the irrigation of only very high value crops.

The Reagan soil is well suited for growing crops; however, yields are low because an adequate amount of water is not available for full irrigation. With full irrigation, cotton would yield about 1,250 pounds of lint per acre, grain sorghum would yield about 90 bushels per acre, and wheat would yield about 40 bushels per acre. With the use of supplemental irrigation, the average lint yield is about 540 pounds; the grain sorghum yield is about 17 bushels; and the wheat and oats yield is about 20 bushels. These yields are achieved with 14 inches of irrigation water on cotton, 8 inches on grain sorghum, and 6 inches on oats.

Water erosion generally is not a hazard because only a very small acreage of sloping land is cropped. Wind erosion, however, is a moderate hazard on the Reagan soil. Wind erosion can damage land in a few hours if the winds are strong and the soil is dry and bare of vegetation. Maintaining a living plant cover, surface mulch, or a rough cloddy surface through deep tillage minimizes the risk of wind erosion. This protection must be on the land during the time between crops and while the crops are small. The highest winds occur during February, March, April, and May. Both plant cover and mulch are effective in even small amounts. For deep tillage to be effective, the surface must be roughened and the tillage deep enough to place clods on the surface. The plant cover is best, however, because it also reduces runoff by increasing water intake, and reduces evaporation by shading the soil surface.

Close-spaced crops, minimum tillage, and fertilization can also be helpful in controlling erosion. Close-spaced crops, like oats and wheat, have very little bare ground. Minimum tillage keeps the plow layer from becoming powdery, keeps the subsoil from becoming compacted, and leaves the stubble from the previous crop on the surface. Fertilization not only increases the crop yield but also increases the amount of litter that can be left on the surface to form a mulch.

When the supply of irrigation water is depleted to the point that cropping is no longer practiced, the fields should be immediately reseeded to suitable native plants. If the fields are abandoned, a very dense stand of mesquite will invade. The successful reestablishment of native plants is difficult because of low rainfall. Supplemental irrigation may be needed to obtain an adequate stand.

Natural fertility of the Reagan soil is high. Some farmers do not fertilize the first few years the land is cropped. Fertilizing older irrigated land increases yields substantially. The nutrients that have the greatest effect on yields are nitrogen and phosphorous, but commercial fertilizers should always be applied according to the results of soil tests.

Few field crops need less irrigation water than cotton and grain sorghum. When the water supply diminishes to where these crops no longer are profitable, the farmers will have to go out of business or switch from extensive irrigation to more intensive irrigation on much smaller acreages. Several wells would have to be combined on a smaller acreage. Switching to drip irrigation can also help make better use of dwindling water supplies. The smaller acreage will need high value crops. Some are now being tried, but many others could be tested. The most promising appear to be Christmas trees, grapes, and cantaloups. Vegetables like tomatoes, onions, peppers, asparagus, beans, carrots, radishes, cucumbers, beets, turnips, squash, spinach, watermelons, and potatoes all grow well on Reagan soil. Spices, flower bulbs, and greenhouse agriculture could also be tested. Any, or all

of these, could develop into a profitable industry. Cooperative marketing could help ensure the success of the enterprise.

Much research and experimentation has been done recently with grapes in Texas. The Reagan soil is well suited to grapes, and yields of eight tons per acre are possible. Grapes have few insect and disease problems in this area. The temperature is suitable for table grapes and for some varieties of wine grapes. However, it is too hot for the finest wine varieties, and damaging hail storms are a hazard. Trickle irrigation works very well because grapes do not require great amounts of water.

The local office of the Natural Resources Conservation Service can assist in the design of irrigation systems that fit the soil, crop, and the water supply. Information is also available regarding the design of erosion control practices for each kind of soil. The Cooperative Extension Service can help choose good varieties and determine the kinds and amounts of fertilizers needed.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, 2e. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w, s,* or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section “Detailed Soil Map Units.”

Windbreaks and Environmental Plantings

High winds are common in the survey area, and the hazard of wind erosion on Reagan loam, the most common cropland soil, is moderate. In winter and spring, wind blows unprotected soils, damaging plants in gardens and orchards. Windbreaks that include evergreen shrubs and trees provide protection for the soils and make the area around the home more pleasant.

Windbreaks at right angles to the prevailing winds work best. They should include both shrubs and trees and can be from 3 to 5 rows in width. The wind erosion protection extends for a distance 20 times the height of the tallest windbreak plants. In some years, windbreaks trap enough snow to wet the whole soil. One or two rows of plants, closely spaced, should be evergreen shrubs or trees.

Not all windbreaks need to be woody plants. Good temporary protection is provided by two rows of tall

sorghum planted at right angles to the wind. This is a quick, easy, and effective windbreak. It can be used to protect a newly planted permanent windbreak or it can be used to slow the winds in gardens, orchards, and vineyards.

Irrigation, weed control, spacing, and careful selection of plants are all important to ensure survival. The first 3 years following planting are the most important.

Environmental plantings around the home beautify, prevent wind damage to gardens and orchards, reduce heating and cooling expenses in the home, and attract wildlife. Tall broad-leaf trees are a good choice on the south and west side of a home. In the summer, the home is cooler because it is shaded. In the winter, the leaves are gone and the sun can heat the home.

Native plants are always the most trouble free. Evergreens, such as live oak, senecio, mescalbean, four-wing saltbush, and juniper are easy to care for, once established. However, all are not easy to transplant. When irrigation is impossible, trees, such as hackberry, juniper, Texas sophora, western soapberry, and bumelia can be used. Even these drought-tolerant trees benefit from the extra water they receive as runoff when they are planted in shallow depressions. A depression that is 3 to 10 inches deep and 20 to 40 feet across allows extra water to collect around the newly planted tree.

All plantings need not be evergreens. Some fruit-bearing plants can successfully be made a part of the plantings. Native wild plums, apricots, crab apples, pecan, grapes, red mulberries, and blackberries can reduce the winds for a large part of the year. Flowering plants, such as redbud, desert willow, and lilac, add beauty. Fruit trees, multiflora rose, elms, oaks, ash, and Arizona cypress all attract wildlife.

Plants that are readily available but that should be avoided are Chinese elm, fruitless mulberry, and Arizona ash. The elm is attacked by leaf-eating insects. Fruitless mulberry has many twigs that die back in winter, attracts house sparrows with their trashy nests, and does not provide any fruit for birds. The Arizona ash is often attacked by woodborers.

Landscaping and Gardening

Landscaping is easier if the natural topography and vegetation are preserved during home construction. Large cuts and fills are difficult to protect from erosion and are difficult to hide. Cuts in Noelke, Ector, and Lozier soils expose bedrock, making plant cover especially hard to establish. Large areas of fill make poor foundations, and too much fill over tree roots can kill the trees.

Most yard and garden plants do best in soils that are deep, friable, loamy, and fertile. Many of the soils in the survey area meet these requirements. Because garden areas are small, unfavorable soil characteristics can be modified. The hard-to-till surface layer of Angelo, Mereta, Rioconcho, and Tobosa soils can be improved by working in organic material, such as compost, manure, or leaves and grass clippings. Working organic material deeply into the soil increases the water intake rate. This is especially needed for the Tobosa soil because it has a dense clay subsoil.

Large plants, such as pecans, pears, oaks, and grapes, require less care if they are planted on the deepest soils. Soils with adequate depth are Reagan, Angelo, Kinco, Penwell, Pyote, Reeves, Sanderson, and Wickett soils. Rioconcho and Iraan soils also have adequate depth but are occasionally flooded. Topsoil may have to be imported if homes are built on shallow and very shallow soils, such as Ector, Lozier, and Noelke soils.

The yellowing of plants, although sometimes a symptom of disease, usually indicates that fertilizer is needed. Fertilizers should always be applied according to soil tests. In the absence of tests, there are some general guidelines. Yellowing caused by an iron deficiency results when there is an excess of calcium carbonate (lime) in the soil. Iron, in the presence of large amounts of calcium carbonate, forms compounds that will not dissolve in water, making the iron unavailable to plants. Yellowing may occur during periods of rapid plant growth on Conger, Reagan, Hollomex, Reeves, and Sanderson soils. Peaches, pyracanthas, grapes, roses, blackberries, pears, strawberries, beans, black-eyed peas, and St. Augustine grass can turn yellow because of an iron deficiency.

Sometimes the deficiency can be corrected by applying manure at rates up to 20 tons per acre. Iron can also be supplied by iron chelates in foliage sprays or by adding iron sulfate or iron chelates to the soil. Sprays on foliage are effective, but must be repeated after a rainfall and when new foliage develops. Soil treatment with iron is typically done annually. It is sometimes more effective if applied in concentrated bands or if the iron sulfate is mixed with about equal parts of sulfur and manure.

In general, only the soil to be irrigated should be fertilized because all fertilizers are salts of some kind. When the soil is dry drought damage will be more severe.

Because all the soils in this area have an abundant supply of calcium carbonate, lime is not needed. Most of the soils are moderately alkaline or mildly alkaline

and have a pH near 8. The exception is Penwell soil, which is neutral and has a pH near 7.

Nitrogen is the main fertilizer needed on lawns. Plants need large amounts of nitrogen to grow rapidly and to keep a dark green color. To make the best use of nitrogen fertilizer, it should be applied as close as possible to the time of plant growth. Three applications during the time of plant growth are better than one large application before planting time.

Phosphorus is needed to ensure good seed or fruit production. Phosphorus plus nitrogen usually is best for gardens. Like iron, phosphorus readily reacts with the calcium compounds in all limy soils and forms compounds in which the phosphorus is unavailable to plants. To ensure an adequate supply, phosphorus must be added in great quantities or applied in pellet form or as a concentrated band. Phosphorus is not mobile. It should be applied before planting at a depth where roots will contact it.

Most of the soils in the survey area have an adequate supply of potassium; however, it should be added if the soils have been irrigated for a long time. It is essential for high yields.

Adequate amounts of the trace elements, such as boron, copper, zinc, and manganese, are generally present in all the soils or are supplied by an occasional application of manure. Pecan trees in moderately alkaline soils may need zinc. Periodic foliage sprays containing zinc are the only effective treatment.

Recreation

The soils of the survey area are rated in table 6 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 6, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 6 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 8 and interpretations for dwellings without basements and for local roads and streets in table 7.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the

soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Stephan A. Nelle, biologist, Natural Resources Conservation Service, prepared this section.

Wildlife is an important natural resource of Reagan and Upton Counties. Historically, the kinds and number of wildlife have changed considerably since European settlement. The landscape appearance has changed with changes in grazing management and cessation of widespread wildfires. Semiopen grasslands have been replaced by brush of moderate or thick density and a thinner and less diverse cover of grasses and forbs. Animals that no longer inhabit the survey area include bison, gray wolf, Montezuma quail, black bear, black-footed ferret, and lesser prairie chicken.

Although more emphasis has traditionally been placed on the management and conservation of the relatively few game species, the numerous nongame species are just as much a part of the natural environment and worthy of protection.

Land treatment that promotes maximum plant diversity also favors the greatest wildlife diversity. In 1948, Aldo Leopold, one of the fathers of wildlife conservation, wrote these words: “The outstanding scientific discovery of the twentieth century is the complexity of the land organism. The last word in ignorance is the man who says of a plant or animal what good is it? If the land mechanism as a whole is good, then every part is good whether we understand it or not. To keep every cog and wheel is the first precaution of intelligent tinkering” *(3)*.

The basic habitat needs for any wildlife population are food, cover, and water. Each species of wildlife has unique food, cover, and water requirements. For wildlife to inhabit an area, the land must either naturally provide habitat needs, or it must have human management to provide specific habitat needs.

The soils of Reagan and Upton Counties affect the kinds and amounts of vegetation that are available for wildlife food and cover. Soils also influence the distribution of surface water for wildlife use. However, in most cases, the past and present management of the soils and vegetation have a much greater influence on wildlife than do the soils themselves. Each soil can be managed to either harm or benefit wildlife habitat; therefore, a good understanding of soils and vegetation is essential for proper wildlife management.

In the survey area, the management practices that affect wildlife habitat include past and present grazing management, past and present brush control efforts, livestock water development, and the planting and irrigating of cultivated crops. In certain areas, oil field development has had an effect on wildlife habitat.

About 45 native species of mammals exist in the survey area, including about 20 species of rodents and 3 kinds of rabbits. These animals, with their burrowing and insect eating habits as well as their consumption of many “weedy” kinds of plants and seeds, are important to the natural balance although they sometimes conflict with use of the land. Several kinds of bats, with their voracious appetites for insects, are in the survey area. About 10 species of native meat-eating mammals are in the two counties.

Because of the conflict between predators and livestock raisers, trapping and other predator control efforts are common. However, these animals play an essential role in keeping rodent, rabbit, deer, and pronghorn populations in balance.

Four species of large grazing animals are in the survey area, including the pronghorn, javelina, white-tailed deer, and mule deer. Although no more important than other wildlife, these animals are often highly regarded because of the economic asset they can contribute to ranching enterprises. Ranchers commonly lease hunting rights to sportsmen, who act as regulated predators.

The white-tailed deer population varies from about 3,000 to 8,000 animals because of periodic droughts. They are well distributed throughout the survey area except in cropland areas, in which populations are scattered and sparse because of a limited yearlong food supply. Concentrations do occur near areas of cropland, which are used for feeding. Heaviest white-tailed deer densities are about 10 to 25 acres per deer.

A small, but stable population of mule deer exist in the southern and western parts of the survey area where Ector, Lozier, Tencee, and Upton soils are dominant. Densities in the better habitat vary from 75 to 100 acres per deer.

Both kinds of deer prefer to feed on green forbs, which are higher in nutritional quality than either browse or green grasses. However, because of the seasonal availability of annual forbs and the lack of the preferred perennial forbs, deer use browse to make up the bulk of their diet. Periodic die-offs and poor fawn survival combine to keep the populations relatively low. Deer require substantial areas of moderate to thick brush, not only for food, but also for cover and shade. Tall and dense areas of grass among brush are preferred fawning cover.

A healthy population of pronghorn exists in the eastern part of Reagan County (fig. 14). Animals trapped from this herd have been used to restock pronghorn in other suitable habitat in Texas. Pronghorn

Figure 14.—Pronghorns are common in Reagan County.

do not require brush for escape cover but rely more on their keen eyesight and speed to detect and flee from danger. Their preferred diet consists primarily of green forbs, but they also eat considerable browse. Like deer, they do not eat much grass, but require grass cover to hide fawns from predators. During dry periods, they must be able to find green browse and sometimes they must travel great distances to find it. Since the movement of pronghorn is restricted by conventional net wire fences, large pastures are normally considered essential for their survival. In lieu of large pastures, net wire fences can be modified or replaced by barb wire fencing to allow pronghorn movement to other pastures.

Both kinds of deer and the pronghorn have increased their numbers in the past 30 to 50 years. The elimination of the screw worm fly and the widespread development of livestock water have contributed to these increases.

Heavy and continuous yearlong grazing by livestock, especially sheep and goats, is detrimental to the habitat of deer and pronghorn. Under these conditions, competition for the preferred food plants limits the food supply and leads to reduced numbers. Grazing management that favors deer and pronghorn includes moderate stocking rates, grazing rotations that provide periodic pasture deferment, and grazing primarily with cattle.

Large scale brush control can also be detrimental to deer habitat. However, selective or patterned brush control can be beneficial to deer, since deer prefer to feed in small clearings with brushy cover nearby. In the more hilly terrain where brush is more dense, white-tailed deer will be favored and will increase. Where brush is less dense, the mule deer will be favored and will increase.

Scattered bands of javelina exist primarily where the heaviest brush and pricklypear cactus occur. Javelina eat primarily pricklypear pads and fruits; mesquite beans; and yucca and lechugilla flower stalks, leaves, and roots. They also eat some grasses, forbs and browse, insects, rodents, and carrion.

The bird life of Reagan and Upton Counties is also quite diverse. About 170 kinds of birds are common enough to be seen each year. About 30 of these are permanent yearlong residents; the rest are migratory. About 80 species are known to nest in the survey area.

Each bird species has its own unique habitat requirements for food, cover, and water. Some prefer sparsely vegetated land, some prefer grasslands, and others prefer thick brush. Some birds eat insects only or succulent berries and fruits, while others prefer to eat small seeds or meat. Nesting and roosting requirements likewise vary widely among birds.

The intermittent lake beds that occur on the Tobosa and Ekal soils are filled with water after rainy periods and, therefore, attract migrating water birds and shore birds. These birds feed on the great numbers of fairy shrimp as well as the vegetation and seeds that these areas support.

Raptorial birds of prey are common and include Mississippi kite, marsh hawk, Swainson's hawk, Harris' hawk, red-tailed hawk, American kestrel, and owls. Golden eagles are present from November to March. Turkey vultures are the primary carrion eaters.

A large group of birds in the survey area are almost exclusively insect eaters. The more common ones include nighthawks, poorwills, woodpeckers, flycatchers, swallows, wrens, warblers, and vireos. The loggerhead shrike and roadrunner not only eat insects, but also reptiles and mice. Another group of birds eat primarily seeds. These include longspurs, buntings, sparrows, grosbeaks, cardinals, pyrrhuloxia, goldfinches, and doves. Birds that readily eat insects, fruits, or seeds include horned larks, cedar waxwings, mockingbirds, thrashers, bluebirds, robins, titmice, tanagers, orioles, blackbirds, meadowlarks, cowbirds, house sparrows, and starlings.

All of these birds have definite aesthetic and ecological value even if they have no direct economic value. Birds are also important to the natural balance in seed dispersal and seed and insect consumption.

Upland game birds are also common in the survey area. These include mourning dove, bobwhite quail, scaled quail, and turkey. These birds are hunted throughout the county and the leasing of hunting rights is an economic asset. Landowners sometimes perform specific management practices intended to increase the numbers of these birds.

The two quail species spend their entire life in a rather small area, and therefore must have all their habitat needs close together. Nesting cover consists of large clumps of grass left from the previous year. Heavy grazing then can greatly limit nesting success. Quail feed primarily on the hard seeds of forbs, grasses, and some brush species. In many cases, it is the "weedy" kinds of plants that produce the best quail food. These plants normally grow best on soil that is disked or has significant bare areas. Quail require low-growing brush for cover and protection from hot summer sun, cold winter winds, rain, and predators. The best quail habitat consists of areas with scattered, low-growing, thick bushes interspersed with bunchgrasses, bare ground, and forbs. Bobwhites do better in rainy years when there is abundant ground cover. Scaled quail do better in drier years with less ground cover. The presence of surface water is not considered essential for quail. However, in dry years, water sources will be used and will increase quail survival.

Turkeys range over a much wider area than do quail and will travel 10 to 30 miles to find suitable habitat. They also require large clumps of grass or weeds to nest in and are affected by heavy grazing. They eat fruits and seeds of forbs, brush, and cactus as well as grass seed. Young, succulent grasses and forbs are also grazed, and insects are essential for the young. Turkeys need considerable brush for escape and concealment as well as food. They roost in tall trees, and are attracted to bottom lands and draws that support large trees. In the absence of trees, they roost on utility transmission poles, oil field tank batteries, and even pump jacks. They must drink water daily and always nest near water. They have benefitted greatly from the development of livestock water.

The mourning dove, a migratory bird, can fly long distances to find suitable food, cover, and water. It eats seeds, and is especially fond of the seeds of agricultural crops and the associated weeds. The mourning dove prefers to feed in areas of bare ground or with sparse cover where seeds can be easily seen. It requires water daily and will fly long distances from feeding grounds to water.

Livestock water troughs do not provide ideal water for quail, turkeys, or doves. However, troughs can be modified to provide more suitable ground level water by adding an overflow pipe leading to a small, nearby depression.

An easy way to increase game bird food production on rangeland is the practice of shallow disking in strips. This stimulates the germination and growth of many of the best food plants. Disking leaves the land bare and subject to erosion so it should be done only on level land. On cropland, leaving crop residues, such as sorghum or wheat, on the surface after harvest, helps birds find more waste grain and provides some cover. Leaving a few narrow strips unharvested benefits many birds.

Amphibians are restricted to the seasonally wet depressions and creeks where seasonal waterholes and some kind of livestock exist. Occasionally, enough heavy rains fall to fill some of the larger and deeper natural depressions. These may stay partly full for 1 or 2 years. They are sometimes stocked with channel catfish, black bass, or both, plus a forage fish, such as bluegill sunfish.

Numerous reptiles inhabit the survey area. The ornate box turtle lives on uplands. About 20 species of snakes live in the survey area, including the coachwhip, bullsnake, hognose, king snake, Western diamondback rattlesnake, and the rare Trans-Pecos

copperhead. About 10 species of lizards and skinks are in the area, including the collared lizard, spiny lizard, side blotched lizard, horned lizard, short-horned round-tailed lizard, Great Plains skink, and whiptail. No known threatened or endangered species of plant or animal as listed by the U.S. Fish and Wildlife Service exists in the survey area.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the “Soil Properties” section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 7 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family

dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 8 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 8 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 8 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is

excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site. Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 8 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 9 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 9, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not

evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 10 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments and dikes and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake

rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 16.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 11 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested is given in table 16.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates

determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 12 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, more than 6 percent; and *very high*, greater than 9 percent.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 12, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 13 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep and very deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep to very deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered

flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Table 13 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in table 13 are the depth to the seasonal high water table; the kind of water table—that is, perched, apparent, or artesian; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 13.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone. An *artesian* water table is under hydrostatic head, generally below an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. “More than 6.0” indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

A *cemented pan* is a cemented or indurated subsurface layer within a depth of 5 feet. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high*. It is based on soil texture,

acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 14 and the results of chemical analysis in table 15. The data are for soils sampled at carefully selected sites. Unless otherwise indicated, the pedons are typical of the series. They are described in the section “Soil Series and Their Morphology.” Soil samples were analyzed by the National Soil Survey Laboratory, National Resources Conservation Service, Lincoln, Nebraska.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an ovendry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods *(8)*.

Sand—(0.05-2.0 mm fraction) weight percentages of material less than 2 mm (3A1).

Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all material less than 2 mm (3A1).

Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of material less than 2 mm (3A1).

Water retained—pressure extraction, percentage of ovendry weight of less than 2 mm material; 1/3 or 1/10 bar (4B1), 15 bars (4B2).

Exchangeable sodium percentage— (5D2).

Air dry bulk density—of less than 2 mm material, saran-coated clods (4A1b).

Organic carbon—dichromate, ferric sulfate titration (6A1c).

Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (6O2), sodium (6P2), potassium (6Q2).

Cation-exchange capacity—ammonium acetate, pH 7.0 (5A1a).

Cation-exchange capacity—sodium acetate, pH 8.2 (5A2a).

Reaction (pH)—1:1 water dilution (8C1f).

Electrical conductivity—saturation extract (8A3a).

Engineering Index Test Data

Table 16 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section “Soil Series and Their Morphology.” The soil samples were tested by the Texas Department of Highways and Public Transportation Soil Laboratory, Austin, Texas.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); D 698 (ASTM); Shrinkage—T 92 (AASHTO), and D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(7)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning burnt or dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Calciustolls (*Calci*, meaning lime, plus *ustoll*, the suborder of the Mollisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aridic* identifies one subgroup of the great group. An example is Aridic Calciustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, superactive, thermic Aridic Calciustolls.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the “Soil Survey Manual” *(9)*. Many of the technical terms used in the descriptions are defined in “Soil Taxonomy” *(7)*. Unless otherwise indicated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section “Detailed Soil Map Units.”

Angelo Series

The Angelo series consists of very deep, well drained, moderately slowly permeable soils on nearly level to gently sloping plains and in valleys above normal overflow. These soils formed in calcareous loamy and clayey materials. Slopes range from 0 to 3 percent.

Angelo soils are similar to Reagan soils and are commonly adjacent to Ector, Mereta, and Rioconcho soils on the landscape. Reagan soils have a surface layer that is lighter in color than that of Angelo soils. The shallow or very shallow Ector soils are on hills

adjacent to and above Angelo soils. The shallow Mereta soils typically are at slightly higher elevations and have convex slopes. The very deep Rioconcho soils are on flood plains.

Typical pedon of Angelo silty clay loam, 0 to 1 percent slopes; from the intersection of U.S. Highway 67 and Texas Highway 33 in Big Lake, 7.2 miles east on U.S. 67, 5.4 miles south on a county road, 50 yards east in rangeland:

A1—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; very hard, firm, sticky, plastic; few fine roots; few fine pores; few wormcasts; slightly effervescent; moderately alkaline; clear wavy boundary.

A2—5 to 11 inches; grayish brown (10YR 5/2) silty clay loam, dark brown (10YR 3/3) moist; moderate fine granular and subangular blocky structure; hard, firm, sticky, plastic; few fine roots, few fine pores; few wormcasts; few hard calcium carbonate fragments 0.5 to 2.0 inches in diameter; slightly effervescent; moderately alkaline; gradual wavy boundary.

Bw—11 to 30 inches; brown (7.5YR 5/4) silty clay, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; extremely hard, very firm, sticky, plastic; few fine roots; few fine pores; few hard calcium carbonate fragments 0.125 to 0.5 inch in diameter; few dry weather cracks about 0.5 inch wide filled with darker soil material; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—30 to 50 inches; pinkish white (7.5YR 8/2) silty clay loam, pink (7.5YR 8/4) moist; weak medium subangular blocky structure; very hard, firm, slightly sticky, plastic; 10 percent visible calcium carbonate concretions, threads, and masses; strongly effervescent; moderately alkaline.

Bk2—50 to 80 inches; pinkish white (7.5YR 8/2) silty clay loam, pink (7.5YR 8/4) moist; weak medium subangular blocky structure; very hard, firm, slightly sticky, plastic; 2 percent calcium carbonate concretions, threads, and masses; violently effervescent; moderately alkaline.

Depth to the Bk horizon ranges from 24 to 40 inches. The solum is 60 to more than 80 inches thick.

The A horizon is brown, grayish brown, or dark grayish brown. Many pedons have a weak, thin platy structure to a depth of 1 inch.

The Bw horizon is brown and light brown. It is predominantly silty clay loam; however, it can range to silty clay and clay.

The Bk horizon is light brown and pinkish white. It is dominantly silty clay loam; however, it can range to clay loam, gravelly clay loam, and clay. The calcium carbonate equivalent ranges from 15 to 40 percent. Visible calcium carbonate threads, concretions, and masses range, by volume, from 10 to 20 percent in the upper part and from 5 to 10 percent in the lower part.

Blakeney Series

The Blakeney series consists of soils that are shallow to a petrocalcic horizon. These soils are well drained and moderately rapidly permeable and formed in calcareous loamy materials. Typically, they are on long, gently sloping footslopes. Slopes range from 1 to 3 percent.

Blakeney soils are similar to Conger soils and commonly are adjacent to Conger, Kinco, Tencee, and Upton soils on the landscape. Conger soils have a higher content of clay and more organic matter in the A horizon than Blakeney soils. They are in positions similar to those of Blakeney soils. Kinco soils are in lower positions and are deeper than Blakeney soils. Tencee soils have a very gravelly loam surface layer, and Upton soils have a gravelly loam surface layer. Tencee and Upton soils are in positions similar to those of Blakeney soils.

Typical pedon of Blakeney fine sandy loam, 1 to 3 percent slopes; 0.2 mile north of the Crockett County line on ranch road 1901, 60 yards west of the right-of-way fence in rangeland:

A—0 to 7 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky, nonplastic; few fine roots; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw—7 to 14 inches; strong brown (7.5YR 5/6) fine sandy loam, strong brown (7.5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable, nonsticky, nonplastic; few fine roots; layer of calcium carbonate concretions 0.25 to 4.0 inches across in the lower part; strongly effervescent in the lower part; moderately alkaline; abrupt wavy boundary.

Bkm—14 to 25 inches; white (10YR 8/2) indurated calcium carbonate, very pale brown (10YR 8/3) moist; smooth, continuous laminar cap in the upper 0.25 inch and rough on the lower side; violently effervescent; moderately alkaline; clear wavy boundary.

BCk—25 to 80 inches; white (10YR 8/1) gravelly loam,

pinkish white (7.5YR 8/2) moist; massive; violently effervescent; moderately alkaline.

Depth to the Bkm horizon ranges from 9 to 18 inches.

The A horizon is brown, light brown, and yellowish brown. In most pedons, this horizon is noncalcareous and has a pH near 8.0; however, in some pedons it is calcareous.

The Bw horizon is brown, light brown, strong brown, and yellowish brown. This horizon is fine sandy loam; however, in some pedons a gravelly or very gravelly layer 1 to 2 inches thick is immediately above the Bkm horizon. The gravel is indurated calcium carbonate. Most pebbles are rounded, except for larger ones that are flattened. They are smooth on the top and rough on the bottom. In most pedons, this horizon is noncalcareous and has a pH of 8.0; however, in some pedons, it is calcareous throughout. In almost all pedons, this horizon is calcareous in the lower 2 inches.

The Bkm horizon is 2 to 24 inches thick.

The BCk horizon is calcareous loam and gravelly loam. It has varying amounts of hard calcium carbonate, limestone, ironstone, and quartzite pebbles.

Conger Series

The Conger series consists of soils that are shallow to a petrocalcic horizon (fig. 15). These soils are well drained, moderately permeable, and have a very slowly permeable petrocalcic horizon. They formed in calcareous loamy materials. They are on nearly level tops of limestone hills and on low knolls on nearly level to gently sloping plains. Slopes range from 0 to 3 percent.

Conger soils are similar to Blakeney and Upton soils and are commonly adjacent to Ector, Lozier, Reagan, Tencee, and Upton soils on the landscape. Blakeney soils have less clay than Conger soils. Tencee and Upton soils are in positions on the landscape similar to those of Conger soils; however, they have more gravel and carbonates than Conger soils. Ector and Lozier soils are in higher positions over hard limestone bedrock. Reagan soils are deeper than Conger soils and commonly are in slightly lower areas on the landscape.

Typical pedon of Conger loam from an area of Conger-Reagan association, 0 to 3 percent slopes; from the intersection of U.S. Highway 67 and Texas Highway 137 in Big Lake, 9.4 miles west on Highway 67, 13.7 miles north on county road, 3.0 miles west and northwest on county road, 100 yards east in rangeland:

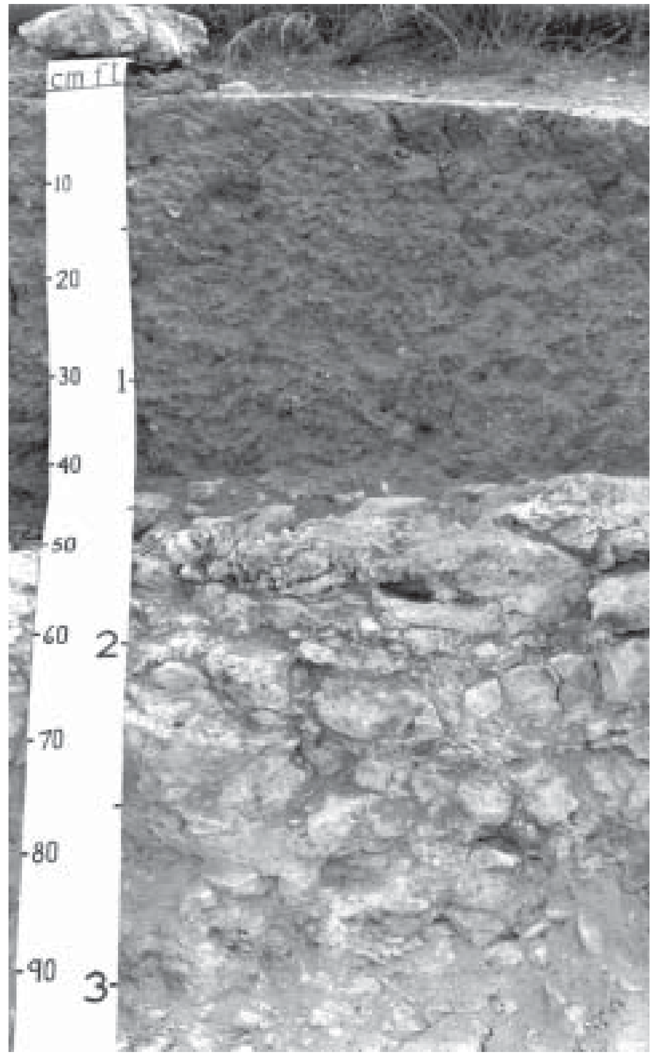

Figure 15.—A profile of Conger loam. This soil is underlain at a shallow depth by a petrocalcic horizon.

A—0 to 8 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few fine roots; few fine pores; weak platy structure to depth of 1 inch, weak surface crust 0.125 inch thick; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw—8 to 15 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few fine roots; few fine pores; 5 percent calcium carbonate concretions 0.125 to 2.0 inches across, most in lower 2 inches; violently effervescent; moderately alkaline; abrupt wavy boundary.

Bkm—15 to 21 inches; pinkish white (7.5YR 8/2) indurated calcium carbonate, pink (7.5YR 7/4) moist; continuous and laminar in the upper 0.25

inch; violently effervescent; moderately alkaline; clear wavy boundary.

BCk—21 to 80 inches; pinkish white (7.5YR 8/2) clay loam, light brown (7.5YR 6/4) moist; 25 percent weakly cemented to strongly cemented calcium carbonate; violently effervescent; moderately alkaline.

Depth to the Bkm horizon ranges from 10 to 20 inches.

The A horizon is brown, pale brown, light brownish gray, or pinkish gray. In some pedons, a few pebbles are on the surface or in the upper few inches of the horizon.

The Bw horizon is pale brown, light brown, or light yellowish brown. Hard calcium carbonate pebbles and fragments 0.25 to 4.0 inches across are in most pedons. The larger fragments are flattened, smooth on top, and rough on the bottom. Pebbles and fragments make up 2 to 15 percent of the horizon.

The Bkm horizon ranges from 5 to 24 inches thick. In some pedons, the upper 2 to 6 inches can be broken out in plates with a spade. The rest of the horizon is continuous and much harder.

The BCk horizon is calcareous clay loam or gravelly clay loam that, in some areas, has calcium carbonate concretions and quartzite pebbles. Coarse fragments range from 5 to 30 percent.

Ector Series

The Ector series consists of soils that are very shallow or shallow to limestone bedrock (fig. 16). These soils are well drained and moderately permeable and have many fragments of limestone. They are on hillsides and hilltops. Slopes range from 3 to 30 percent.

Ector soils are similar to Lozier soils and commonly are adjacent to Angelo, Conger, Mereta, Noelke, and Reagan soils on the landscape. Lozier soils are lighter in color than Ector soils. The very deep Angelo soils are in valleys and on high, nearly level plains. Conger soils are lighter in color, are less gravelly, and typically are at lower elevations than Ector soils. Mereta soils are in positions on the landscape similar to those of Ector soils. They have less gravel and are more clayey than Ector soils. Noelke soils have less carbonates than Ector soils. Reagan soils are deeper than Ector soils.

Typical pedon of Ector very gravelly loam, 3 to 8 percent slopes; from the intersection of Texas Highway 137 and U.S. Highway 67 in Big Lake, 12 miles north on Texas Highway 137 to Texas Highway 33, 6.75 miles north on Texas Highway 33, 2.9 miles east on ranch road, 105 yards south of road in rangeland:

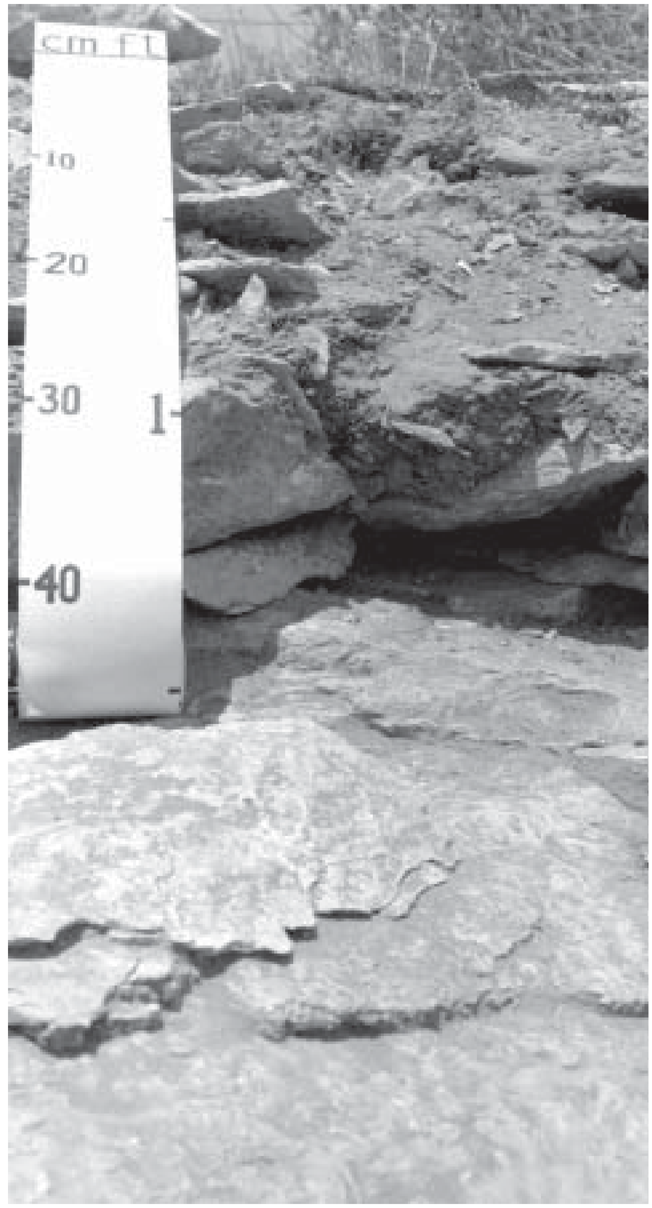

Figure 16.—A profile of Ector very gravelly loam. This soil contains many limestone fragments and is underlain by limestone bedrock.

A—0 to 6 inches; grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable, slightly sticky, slightly plastic; few fine roots; 75 percent of surface covered with limestone and hard calcium carbonate fragments; 10 percent stones, 10 percent cobbles, 30 percent pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bk—6 to 14 inches; grayish brown (10YR 5/2) very cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard,

friable, slightly sticky, slightly plastic; few fine roots; few fine pores; 10 percent stones, 20 percent cobbles, 30 percent pebbles; many smaller pebbles of calcium carbonate; hard calcium carbonate coating up to 1 inch thick on many larger fragments that are smooth on top and rough on the bottom; strongly effervescent; moderately alkaline; abrupt wavy boundary.

R1—14 to 30 inches; white (10YR 8/2) fractured hard limestone that has 0.25-inch-thick indurated calcium carbonate coating the surface and filling all fractures; violently effervescent; moderately alkaline; gradual wavy boundary.

R2—30 to 80 inches; white (10YR 8/2) fractured limestone, horizontally bedded.

The A and Bk horizons have a combined thickness that ranges from 6 to 20 inches. Indurated calcium carbonate fragments and limestone fragments make up 35 to 60 percent. These horizons are grayish brown, brown, or dark grayish brown. About 55 percent of the pedons are stony, about 90 percent have some cobbles, and all have gravel.

The underlying limestone is white, pale yellow, or very pale brown.

Ekal Series

The Ekal series consists of very deep, somewhat poorly drained, very slowly permeable, saline, clayey soils. These soils are on floors of intermittent lakes that are 20 to 50 feet lower in elevation than the surrounding plains. Slopes are 0 to 1 percent and are typically concave.

Ekal soils are similar to Tobosa soils and commonly are adjacent to Hollomex, Reagan, and Reeves soils on the landscape. Tobosa soils are not saline. They are on floors of smaller, intermittent lakes. Hollomex soils are shallow over gypsiferous materials. They are on higher convex slopes. Reagan soils are very deep and loamy and are on higher, nearly level plains. Reeves soils have gypsiferous materials at a depth of more than 20 inches.

Typical pedon of Ekal clay, 0 to 1 percent slopes, depressional; from the intersection of U.S. Highway 67 and Texas Highway 137 in Big Lake, 2 miles south on Highway 137, 180 yards west in rangeland:

A—0 to 8 inches; gray (10YR 5/1) clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky, very plastic; common fine and medium roots; strongly effervescent; moderately saline, moderate sodicity; moderately alkaline; clear smooth boundary.

An—8 to 15 inches; gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; moderate fine angular blocky structure; extremely hard, very firm, very sticky, very plastic; common fine roots; strongly effervescent; strongly saline, moderate sodicity; moderately alkaline; clear smooth boundary.

Bn1—15 to 22 inches; light gray (10YR 6/1) clay, dark gray (10YR 4/1) moist; moderate fine and medium angular blocky structure; vertical cracks 0.33 inch wide filled with soil from above; extremely hard; very firm, very sticky, very plastic; strongly effervescent; strongly saline, strong sodicity; moderately alkaline; gradual wavy boundary.

Bn2—22 to 36 inches; light gray (10YR 6/1) clay, dark gray (10YR 4/1) moist; moderate fine angular blocky structure; extremely hard, very firm, very sticky, very plastic; few white aggregates of salts 0.125 to 0.25 inch in diameter; few, fine brown (7.5YR 4/4 moist) masses of iron accumulation and streaks along root channels; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bn3—36 to 48 inches; light gray (10YR 6/1) clay, gray (10YR 5/1) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky, very plastic; few white masses of salts 0.125 to 0.25 inch across; strongly effervescent; strongly saline, moderate sodicity; moderately alkaline; gradual wavy boundary.

BCn—48 to 57 inches; light gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) moist; moderate medium subangular blocky structure; extremely hard, very firm, sticky, plastic; strongly effervescent; strongly saline, moderate sodicity; moderately alkaline; gradual wavy boundary.

BCny—57 to 80 inches; white (2.5Y 8/2) clay loam, light gray (2.5Y 7/2) moist; extremely hard, very firm, sticky, plastic; 15 percent gypsum crystals; strongly effervescent; strongly saline, moderate sodicity; moderately alkaline.

The solum is 60 to more than 80 inches thick. Clay content of the control section ranges from 40 to 55 percent. Calcium carbonate equivalent ranges from 15 to 40 percent throughout. Linear extensibility exceeds 6 centimeters in the upper 40 inches.

The A horizon is gray, dark gray, grayish brown, or light brownish gray. Salinity ranges from 8 to 16 mmhos per centimeter. SAR (sodium adsorption ratio) ranges from 13 to 25 percent.

The B horizon is gray, light gray, light brownish gray, or grayish brown clay or silty clay. Salinity ranges from 16 to 40 mmhos per centimeter. SAR ranges from 15 to 40 percent.

The BC and C horizons are light gray, light brownish

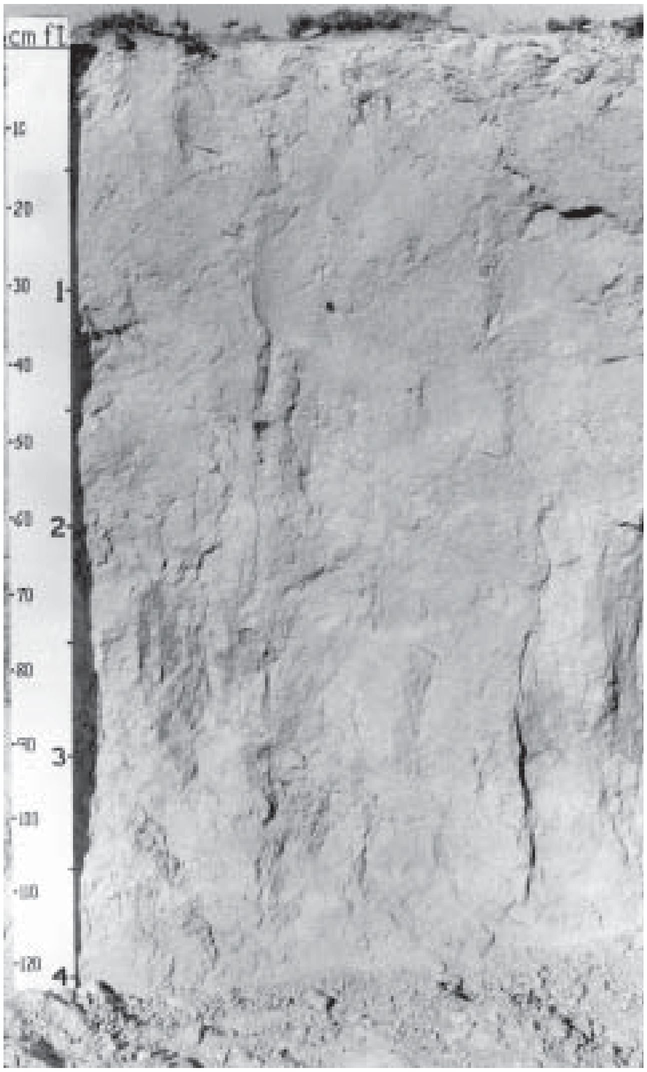

Figure 17.—A profile of Hollomex loam. This soil contains a large amount of gypsum and is light gray or white.

gray, or white. Salinity ranges from 16 to 40 mmhos per centimeter, and calcium sulfate ranges, by volume, from 10 to 30 percent. SAR ranges from 15 to 30 percent. Some pedons do not have BC and C horizons.

Hollomex Series

The Hollomex series consists of soils that are shallow to gypsiferous materials (fig. 17). These soils are well drained, nearly level to moderately sloping, and moderately permeable. They formed in calcareous and gypsiferous eolian deposits around intermittent lakes. Slopes typically are convex and range from 1 to 8 percent.

Hollomex soils are similar to Reeves soils and commonly are adjacent to Ekal, Reeves, Reagan, and Tobosa soils on the landscape. On Reeves soils, the depth to gypsiferous materials is more than 20 inches. These soils typically are at lower elevations. Ekal and Tobosa soils formed in the clayey beds of intermittent lakes. The very deep Reagan soils are on nearly level plains.

Typical pedon of Hollomex loam, 1 to 8 percent slopes; from the intersection of U.S. Highway 67 and Texas Highway 137 in Big Lake, 30.2 miles north on Highway 137, 9.2 miles west and north on ranch road 1357, 20 yards west in rangeland:

A—0 to 10 inches; light gray (10YR 7/2) loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to moderate fine granular; slightly hard, friable, nonsticky, nonplastic; few fine roots; few fine pores; upper 1 inch weak platy, surface crust 0.25 inch thick; strongly effervescent; moderately alkaline; abrupt smooth boundary.

BCky—10 to 30 inches; white (2.5Y 8/2) loam, light gray (2.5Y 7/2) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; upper 1 inch is weakly cemented and stops most roots; many masses of gypsum and calcium carbonate, most powdery; violently effervescent; moderately alkaline; diffuse wavy boundary.

Cky—30 to 80 inches; white (2.5Y 8/2) loam, light gray (2.5Y 7/2) moist; weak fine subangular blocky structure; hard, firm, nonsticky, nonplastic; mostly powdery gypsum and calcium carbonate; violently effervescent; moderately alkaline.

The solum is 2 to 10 inches thick over weakly cemented gypsiferous deposits. Most pedons are very slightly saline. Conductivity of the saturation extract ranges from 1 to 4 mmhos per centimeter.

The A horizon is light gray, white, very pale brown, or light brownish gray.

The BCky horizon is white or light gray. Masses of calcium carbonate and gypsum range from none to 15 percent. In most pedons, this horizon is weakly cemented in the upper 1 to 2 inches. Roots penetrate this layer to a depth of 2 to 14 inches. In some pedons, the roots are confined to narrow cracks about 6 inches apart.

The Cky horizon consists of gypsum deposits to a depth of more than 6 feet. Gypsum and calcium carbonate become harder with depth, although they can still be cut with a soil auger at a depth of 80 inches.

These soils are taxadjuncts to the Hollomex series because of a gypsic diagnostic horizon and higher color values in the A horizon. These variations do not significantly affect the use and management of these soils.

Iraan Series

The Iraan series consists of very deep, well drained, moderately slowly permeable soils that formed in calcareous, loamy alluvial sediments. They are on nearly level flood plains along streams and valley floors along drainageways. They are occasionally flooded. Slopes are less than 1 percent.

Iraan soils are similar to Rioconcho soils and are commonly adjacent to Reagan soils on the landscape. Rioconcho soils have more clay in the lower part of the subsoil than Iraan soils. Reagan soils are lighter in color than Iraan soils and are above normal stream overflow.

Typical pedon of Iraan silty clay loam, occasionally flooded; from the intersection of U.S. Highway 67 and ranch road 329 in Rankin, 4.8 miles west on U.S. Highway 67, 70 yards south of the south railroad right-of-way fence, in rangeland:

A1—0 to 4 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate fine granular and subangular blocky structure; hard, friable, sticky, plastic; few fine roots; few fine pores; weak surface crust 0.125 inch thick; slightly effervescent; moderately alkaline; abrupt wavy boundary.

A2—4 to 25 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; hard, friable, sticky, plastic; common fine roots; few fine pores; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bw—25 to 40 inches; light yellowish brown (10YR 6/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; few fine pores; few rounded limestone pebbles less than 1 inch in diameter; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk—40 to 80 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; 3 percent white masses of calcium carbonate up to 0.125 inch in diameter; strongly effervescent; moderately alkaline.

The solum is 60 to more than 80 inches thick.

The A horizon is brown or grayish brown. In many pedons, a lighter color overwash is 1 to 6 inches thick.

The Bw horizon is light brown, pale brown, brown, or light yellowish brown. In some pedons, dry weather cracks are less than 0.5 inch wide.

The Bk horizon is light brown, light yellowish brown, very pale brown, or yellowish brown. In some pedons, the visible calcium carbonate ranges from a few specks or threads to 5 percent, by volume, in the form of masses. In some pedons, the content of rounded limestone pebbles is 2 to 15 percent.

Kinco Series

The Kinco series consists of very deep, well drained, nearly level, moderately rapidly permeable soils that formed in material deposited by wind and water. These soils are in sandy areas at lower elevations on the landscape. Slopes range from 0 to 2 percent.

Kinco soils are similar to Reagan soils and are commonly adjacent to Reagan, Blakeney, Pyote, and Wickett soils on the landscape. Reagan soils are in positions on the landscape similar to those of Kinco soils. They have a loam surface layer. Blakeney soils are higher on the landscape and shallow to a petrocalcic horizon. Pyote and Wickett soils are sandier than Kinco soils and are in areas similar to or higher than those of the Kinco soils on the landscape.

Typical pedon of Kinco fine sandy loam, 0 to 2 percent slopes; from the Crane County line, 5.0 miles east on Texas Highway 329, 2.5 miles north on a county road, 3.7 miles west on a county road, 100 yards south in rangeland, 70 yards west of a north-south cross fence:

A—0 to 12 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; few fine roots; few fine pores; upper 0.125 inch is weak platy surface crust; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bw—12 to 33 inches; pink (7.5YR 7/4) fine sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; few fine roots; few fine pores; slightly effervescent; moderately alkaline; clear wavy boundary.

Bk1—33 to 60 inches; pink (7.5YR 8/4) loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; few fine roots; 10 percent calcium carbonate concretions up to 1 inch in diameter; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bk2—60 to 80 inches; pink (7.5YR 7/4) loam, strong brown (7.5YR 5/6) moist; 1 percent calcium carbonate concretions less than 0.125 inch in diameter diminishing in volume to a few white

specks at a depth of 80 inches; violently effervescent; moderately alkaline.

The A horizon is light brown, pale brown, brown, yellowish brown, or light yellowish brown.

The Bw horizon is mostly fine sandy loam, but it can range to loam. It is light brown or pink.

The Bk horizon is loam or fine sandy loam. It is pink, pinkish white, or light brown. Most pedons are, by volume, about 20 percent calcium carbonate concretions, but some pedons range from few to 60 percent concretions and soft powdery calcium carbonate.

Lozier Series

The Lozier series consists of very shallow or shallow, well drained, moderately permeable soils that formed in loamy materials weathered from limestone bedrock. They are on gently undulating plains and on tops of limestone hills and rolling to very steep side slopes. Slopes range from 2 to 55 percent.

Lozier soils are similar to Ector soils and commonly are adjacent to Conger, Reagan, Sanderson, Tencee, and Upton soils on the landscape. Ector soils are darker than Lozier soils. Conger soils are less gravelly than Lozier soils and have a petrocalcic horizon. They are on less sloping hilltops, footslopes, and knolls. Reagan soils are loamy and very deep. They are on lower and less sloping plains. Sanderson soils are deeper than Lozier soils and are on footslopes. Tencee and Upton soils have a petrocalcic horizon at a shallow depth.

Typical pedon of Lozier very gravelly loam, 15 to 55 percent slopes, very stony; from the intersection of U.S. Highways 67 and 385 in McCamey, 2.8 miles east on U.S. Highway 67, 1 mile north and 0.6 mile west on an oil field road, 100 yards west to a steep hillside in rangeland:

A—0 to 4 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 4/3) moist; weak fine granular and subangular blocky structure; hard, friable, nonsticky, nonplastic; common fine roots; 35 percent limestone and indurated calcium carbonate fragments as much as 16 inches across, 70 percent of surface covered with similar fragments; violently effervescent; moderately alkaline; abrupt wavy boundary.

Bk—4 to 12 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 4/3) moist; weak fine granular and subangular blocky structure; hard, friable, nonsticky, nonplastic; common fine roots; 60 percent limestone and indurated calcium carbonate fragments as much as 18 inches across, most small fragments hard calcium carbonate, larger ones limestone with coating of indurated calcium carbonate 0.25 inch thick, smooth on top, rough on bottom; violently effervescent; moderately alkaline; smooth wavy boundary.

Rk—12 to 24 inches; very pale brown (10YR 8/3) hard fractured limestone, indurated calcium carbonate seals cracks and coats most surfaces; violently effervescent; moderately alkaline; gradual wavy boundary.

R—24 to 80 inches; fractured limestone, horizontally bedded.

The A horizon is pale brown, light yellowish brown, or very pale brown. Content of coarse fragments ranges from 35 to 50 percent.

The Bk horizon is pale brown, light yellowish brown, or very pale brown. Content of coarse fragments, as much as 20 inches across, ranges from 40 to 60 percent. Larger fragments are coated with indurated calcium carbonate as much as 1 inch thick. Some pedons have hard calcium carbonate-coated plates in the lower part of the horizon. Thin seams of darker soil material are between the plates.

The Rk horizon has indurated calcium carbonate coatings as much as 0.75 inch thick on the limestone surfaces. They extend into the cracks to a depth of 12 to 40 inches.

Mereta Series

The Mereta series consists of soils that are shallow to a petrocalcic horizon. They are well drained, nearly level to gently sloping, and moderately slowly permeable. They formed in calcareous loamy and clayey materials. Typically, they are on uplands slightly higher than the surrounding soils. Slopes range from 0 to 3 percent.

Mereta soils are similar to Conger soils and are commonly adjacent to Angelo, Ector, and Noelke soils on the landscape. Conger soils are in positions on the landscape similar to those of Mereta soils. They are lighter in color and less clayey than Mereta soils. Angelo soils are very deep soils in lower positions on the landscape. Ector and Noelke soils typically are on more sloping hillsides, and are less clayey and more gravelly than Mereta soils.

Typical pedon of Mereta clay loam, 0 to 1 percent slopes; from the intersection of U.S. Highway 67 and Texas Highway 137 in Big Lake, 7.2 miles east on Highway 67, 5.3 miles south on a county road, 0.3 mile east on an oil field road, 70 yards south in rangeland:

A—0 to 5 inches; brown (10YR 5/3) clay loam, dark

brown (10YR 3/3) moist; moderate fine granular and moderate fine and medium subangular blocky structure; very hard, firm, slightly sticky, plastic; common fine roots, few fine pores; few earthworm casts; slightly effervescent; moderately alkaline; clear wavy boundary.

Bw—5 to 18 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; moderate fine granular and moderate fine and medium subangular blocky structure; very hard, firm, sticky, plastic; few fine roots; few earthworm casts; few fragments of indurated calcium carbonate 0.05 inch in diameter that increase with depth; strongly effervescent; moderately alkaline; clear wavy boundary.

Bkm—18 to 25 inches; pinkish white (7.5YR 8/2) indurated calcium carbonate, pink (7.5YR 8/4) moist; nearly continuous, very hard and laminar in the upper 0.25 inch; violently effervescent; moderately alkaline; gradual wavy boundary.

BCk—25 to 80 inches; pinkish white (7.5YR 8/2) gravelly clay loam, pink (7.5YR 8/4) moist; 15 percent calcium carbonate concretions and pebbles; violently effervescent; moderately alkaline.

Depth to the indurated calcium carbonate ranges from 14 to 20 inches. Coarse fragments of indurated calcium carbonate on the surface are 0.25 to 3.0 inches across and cover as much as 10 percent of the surface.

The A horizon is brown, grayish brown, or dark grayish brown.

The Bw horizon is brown or grayish brown. The range of textures includes clay loam, silty clay loam, and clay. Fragments of indurated calcium carbonate from 0.25 to 3.0 inches across range from a few in the upper part to as much as 55 percent of the volume of this horizon just above the petrocalcic horizon.

The Bkm horizon is nearly continuous; however, in some pedons, cracks about 3 feet apart allow tree roots to penetrate the underlying material.

The BCk horizon is 5 to 25 percent rounded pebbles. Calcium carbonate concretions are 0.25 to 2.0 inches across. This horizon is pinkish white, white, pink, and very pale brown.

Noelke Series

The Noelke series consists of nearly level to gently sloping soils that are very shallow or shallow to a petrocalcic horizon. These soils are well drained and moderately permeable and formed in material weathered from limestone. Slopes range from 0 to 5 percent.

Noelke soils are similar to Ector soils and are commonly adjacent to Angelo, Ector, and Mereta soils on the landscape. Ector soils have more carbonates than Noelke soils and typically are in steeper areas. The very deep Angelo soils are in the lower valleys and on nearly level plains. Mereta soils are loamy and are in positions on the landscape similar to those of Noelke soils.

Typical pedon of Noelke very gravelly silty clay loam, 0 to 5 percent slopes; from the intersection of U.S. Highway 67 and State Highway 137 in Big Lake, 11.9 miles east on U.S. Highway 67, 0.6 mile south and 0.5 mile west on oil field roads, 40 yards north in rangeland, 70 yards north of railroad track:

A—0 to 5 inches; grayish brown (10YR 5/2) very gravelly silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; hard, firm, sticky, plastic; few fine roots; few fine pores; 40 percent limestone fragments and indurated calcium carbonate fragments as much as 5 inches across, similar fragments covering 25 percent of the surface; slightly effervescent; moderately alkaline; clear wavy boundary.

Ak—5 to 12 inches; brown (10YR 5/3) very gravelly silty clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, firm, sticky, plastic; few fine roots; few wormcasts; 60 percent calcium carbonate concretions as much as 10 inches across, larger ones flattened and smooth on the upper surface and rough on the lower surface; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bkm—12 to 15 inches; pinkish white (7.5YR 8/2) indurated calcium carbonate, continuous, smooth on the upper surface, laminar in the upper 1 inch; violently effervescent; moderately alkaline; abrupt wavy boundary.

R—15 to 80 inches; very pale brown (10YR 8/3) fractured hard limestone; cracks sealed by hard calcium carbonate; violently effervescent.

Depth to the petrocalcic horizon ranges from 6 to 18 inches. Depth to limestone is 7 to 20 inches.

Fragments of limestone and indurated calcium carbonate make up 35 to 60 percent of the A horizon. The calcium carbonate equivalent ranges from 25 to 40 percent for the fragments less than 1 inch in diameter. This horizon is grayish brown, dark grayish brown, and brown. Content of silicate clay ranges from 25 to 35 percent.

The Bkm horizon is 1 to 13 inches thick and extends into cracks in the underlying limestone.

This horizon is white, pinkish white, or very pale brown.

The R horizon is nearly white or light gray fractured limestone that is horizontally bedded.

Penwell Series

The Penwell series consists of very deep soils on undulating uplands. These sandy soils are excessively drained and rapidly permeable. They formed in sandy eolian materials. Slopes range from 1 to 8 percent.

Penwell soils are similar to Pyote soils and commonly are adjacent to Pyote and Wickett soils on the landscape. Pyote and Wickett soils are less sandy than Penwell soils and typically are at slightly lower elevations on the landscape. Wickett soils have an indurated calcium carbonate layer at a depth of about 33 inches.

Typical pedon of Penwell fine sand, undulating; from the Crane County line, 5.0 miles east on Texas Highway 329, 3.1 miles north on a county road, 2.8 miles west on a county road, 0.9 mile north on an oil field road, 30 yards west in rangeland:

A—0 to 15 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 4/4) moist; single grain; loose; few fine and coarse roots; neutral; gradual wavy boundary.

C—15 to 80 inches; reddish yellow (7.5YR 6/6) fine sand, strong brown (7.5YR 5/6) moist; single grain; loose; few fine and coarse roots; neutral.

The A horizon is light brown or pink. It is neutral or slightly alkaline and is noncalcareous.

The C horizon ranges from 65 to 100 inches or more in thickness. It is reddish yellow or pink. It is neutral or slightly alkaline and is noncalcareous.

Pyote Series

The Pyote series consists of nearly level to gently sloping, very deep, well drained, moderately rapidly permeable soils that formed in sandy, windblown deposits. Slopes range from 0 to 3 percent.

Pyote soils are similar to Penwell soils and commonly are adjacent to Kinco, Penwell, and Wickett soils on the landscape. Penwell soils do not have an argillic horizon and are at higher elevations on the landscape. Kinco soils are calcareous and loamy and typically are at lower elevations. Wickett soils have a petrocalcic horizon at a depth of about 33 inches. They are in positions on the landscape similar to those of Pyote soils.

Typical pedon of Pyote loamy fine sand, 0 to 3 percent slopes; from the Crane County line on Texas Highway 329, 5.0 miles east on Texas Highway 329, 3.1 miles north on a county road, 2.8 miles west on a county road, 0.8 mile north on an oil field road, 0.3 mile east on an oil field road, 50 yards south in rangeland:

A—0 to 24 inches; brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky, nonplastic; few fine roots; slightly alkaline; gradual wavy boundary.

Bt1—24 to 42 inches; strong brown (7.5YR 5/6) fine sandy loam, strong brown (7.5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky, nonplastic; few fine roots; clay coatings and bridging of sand grains; moderately alkaline; gradual wavy boundary.

Bt2—42 to 60 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, nonplastic; few fine roots; clay coatings and bridging of sand grains; moderately alkaline; gradual wavy boundary.

Bt3—60 to 80 inches; reddish yellow (7.5YR 6/6) loamy fine sand, strong brown (7.5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; moderately alkaline; gradual wavy boundary.

The solum is 60 to more than 80 inches thick.

The A horizon is brown, strong brown, light brown, reddish yellow, or yellowish red. It is fine sand or loamy fine sand. Reaction is neutral or slightly alkaline.

The Bt horizon is strong brown, reddish yellow, yellowish red, or light brown. Reaction is moderately alkaline or slightly alkaline.

Some pedons have a BCk horizon at a depth of 40 inches. Threads and films of calcium carbonate range from few to 60 percent, by volume. Calcium carbonate concretions that range up to 0.5 inch across make up more than 20 percent of the volume. The BCk horizon is pink, pinkish white, or reddish yellow.

Reagan Series

The Reagan series consists of very deep, well drained, moderately permeable calcareous soils that formed in calcareous loamy materials. These nearly level or very gently sloping soils are on uplands. Slopes range from 0 to 3 percent.

Reagan soils are similar to Angelo, Kinco, and Reeves soils and are commonly adjacent to Angelo,

Conger, Ector, Hollomex, Iraan, Kinco, Lozier, Reeves, Tencee, and Upton soils on the landscape. Angelo soils are darker and more clayey than Reagan soils and are slightly lower on the landscape. Kinco soils have more sand than Reagan soils. Iraan soils are darker than Reagan soils and are on flood plains. Reeves soils have a gypsiferous subsoil. Conger, Ector, Hollomex, Lozier, Tencee, and Upton soils are shallow or very shallow and typically are in higher areas on the landscape.

Typical pedon of Reagan loam, 0 to 1 percent slopes; 9.0 miles south and west of Midkiff on farm road 2401, 500 feet southeast of road, 150 feet east of a fence in rangeland:

A1—0 to 3 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak fine and medium granular structure; slightly hard, friable; common fine roots; surface crust about 0.125 inch thick; slightly effervescent; moderately alkaline; clear smooth boundary.

A2—3 to 8 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; moderate fine and very fine subangular blocky structure; slightly hard, friable; few fine roots; common fine wormcasts, insect cavities, and old root channels; slightly effervescent; moderately alkaline; diffuse smooth boundary.

Bw—8 to 17 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; few fine roots; common fine wormcasts and insect cavities partly filled with material the same color as the A2 horizon; few fine threads and films of calcium carbonate; strongly effervescent; moderately alkaline; diffuse smooth boundary.

Bk1—17 to 30 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; few fine roots; common fine wormcasts and partly filled insect cavities; common fine masses of calcium carbonate in the lower part; violently effervescent; moderately alkaline; clear wavy boundary.

Bk2—30 to 50 inches; reddish yellow (7.5YR 7/6) clay loam, strong brown (7.5YR 5/6) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; 35 percent pinkish white (7.5YR 8/2) fine soft concretions and masses of segregated calcium carbonate; violently effervescent; moderately alkaline; diffuse wavy boundary.

Bk3—50 to 80 inches; reddish yellow (7.5YR 6/6) clay loam; strong brown (7.5YR 5/6) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; 5 percent fine masses of calcium carbonate; strongly effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 15 to 40 inches.

The A horizon is pale brown, light brown, light yellowish brown, light brownish gray, or brown.

The Bw horizon is light brown, very pale brown, or pale brown. It is loam or clay loam.

The Bk horizon is, by volume, 10 to 50 percent visible calcium carbonate. Calcium carbonate concretions range from none to 45 percent. Where this horizon is at or near the minimum depth of 20 inches, the upper part is intermittently weakly or strongly cemented. The Bk horizon is pinkish white, pink, reddish yellow, or light brown. It is loam, clay loam, or clay.

At higher elevations hard limestone is between depths of 5 and 20 feet. Limestone is more than 30 feet below the surface of the valleys.

Laboratory data for this pedon is given in tables 14 and 15.

Reeves Series

The Reeves series consists of soils that have gypsum within depths of 20 to 40 inches. These soils are very deep, well drained, nearly level to undulating, and moderately permeable. They formed in calcareous and gypsiferous materials near intermittent lakes. Slopes range from 0 to 5 percent.

Reeves soils are similar to and commonly adjacent to Ekal, Hollomex, and Reagan soils on the landscape. Ekal soils are in the clayey beds of intermittent lakes. Hollomex soils are shallow and typically are at higher elevations. Reagan soils are in positions on the landscape similar to those of Reeves soils; however, they do not have a gypsiferous subsoil.

Typical pedon of Reeves loam, 0 to 5 percent slopes; from the intersection of U.S. Highway 67 and Texas Highway 137 in Big Lake, 1.4 miles south on Texas Highway 137, 100 yards east in rangeland:

A—0 to 16 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; few fine roots; few fine pores; few wormcasts; platy surface crust 0.125 inch thick; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk—16 to 22 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; moderate fine granular and weak fine subangular blocky

structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; few fine pores; few wormcasts; few white masses of gypsum or calcium carbonate as much as 0.125 inch in diameter in the lower part; strongly effervescent; moderately alkaline; clear wavy boundary.

Bky—22 to 80 inches; white (10YR 8/2) clay loam, light brownish gray (10YR 6/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots in the upper 2 inches; few fine pores; mostly flocculent and powdery gypsum and calcium carbonate, 5 percent white masses of calcium carbonate; violently effervescent; moderately alkaline.

The A horizon is light gray, light brownish gray, or pale brown.

The Bk horizon is pale brown or very pale brown. It is loam or clay loam.

The Bky horizon is white, light gray, or very pale brown. These colors were dominantly inherited from the gypsiferous parent materials. This horizon is slightly hard to very hard but can be cut with a soil auger.

Rioconcho Series

The Rioconcho series consists of very deep, moderately well drained, slowly permeable soils that formed in clayey and silty alluvial materials subject to occasional flooding. Slopes range from 0 to 1 percent.

Rioconcho soils are similar to Iraan soils and commonly are adjacent to Angelo, Ector, Mereta, and Noelke soils on the landscape. Iraan soils have less clay than Rioconcho soils. Angelo soils are above normal overflow. Very shallow and shallow Ector and Noelke soils and shallow Mereta soils are at higher elevations.

Typical pedon of Rioconcho silty clay loam, occasionally flooded; from the intersection of U.S. Highway 67 and Texas Highway 137 in Big Lake, 12.0 miles north on Texas Highway 137 to intersection with Texas Highway 33, 4.5 miles north on Highway 33, 80 yards east:

A1—0 to 16 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular and moderate very fine and medium subangular blocky structure; very hard, firm, sticky, plastic; few fine roots; few fine pores; few wormcasts; dry weather cracks 0.5 to 1.0 inch wide; slightly effervescent; moderately alkaline; gradual wavy boundary.

A2—16 to 30 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; very hard, firm, sticky, plastic; few fine roots; few fine pores; few wormcasts; dry weather cracks 0.33 to 1.0 inch wide; slightly effervescent; moderately alkaline; diffuse wavy boundary.

Figure 18.—A profile of Sanderson very gravelly loam. The gravelly parent material washed down from nearby hillslopes.

Bk—30 to 80 inches; light brown (7.5YR 6/4) silty clay, brown (7.5YR 5/4) moist; moderate medium angular blocky structure parting to moderate fine and medium subangular blocky; very hard, firm, sticky, plastic; few fine pores; few threads of calcium carbonate; strongly effervescent; moderately alkaline.

The solum is more than 80 inches thick. The dark surface layer is 20 to more than 50 inches thick. Dry weather cracks are 0.33 to 1.0 inch wide and extend from the surface to a depth of 40 inches.

The A1 horizon is dark grayish brown, grayish

brown, brown, or gray. The A2 horizon is brown.

The Bk horizon is light brown, very pale brown, light yellowish brown, or pale brown. It is silty clay and clay.

Sanderson Series

The Sanderson series consists of very deep, very gravelly, well drained, gently sloping or moderately sloping, moderately permeable soils (fig. 18). They formed in very gravelly colluvium and are typically on footslopes. Slopes range from 1 to 8 percent.

Sanderson soils are commonly adjacent to Lozier, Tencee, and Upton soils on the landscape. Lozier soils are shallow or very shallow over hard limestone bedrock. They are on higher slopes. Tencee and Upton soils are shallow to a petrocalcic horizon.

Typical pedon of Sanderson very gravelly loam, 1 to 8 percent slopes; from the intersection of U.S. Highways 67 and 385 in McCamey, 12.9 miles north on U.S. Highway 385, 3.3 miles east and northeast on county road, 30 yards north in rangeland:

A—0 to 12 inches; pale brown (10YR 6/3) very gravelly loam, yellowish brown (10YR 5/4) moist; moderate fine granular and subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few fine roots; few fine pores; 40 percent rounded limestone and indurated calcium carbonate pebbles less than 1 inch in diameter, 75 percent of surface covered with similar pebbles; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bk—12 to 53 inches; light yellowish brown (10YR 6/4) very gravelly loam, yellowish brown (10YR 5/4) moist; moderate fine granular and subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few fine roots; few fine pores; 40 percent rounded limestone and indurated calcium carbonate fragments 0.25 to 4.0 inches in diameter; powdery calcium carbonate on the surface of many fragments; few specks of soft calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

C—53 to 80 inches; very pale brown (10YR 8/4) very gravelly loam, brownish yellow (10YR 6/6) moist; weak fine subangular blocky structure; hard, friable, slightly sticky, slightly plastic; 50 percent rounded limestone pebbles; violently effervescent; moderately alkaline.

The solum is 40 to 80 inches thick. In most pedons coarse fragments make up from 35 to 45 percent of the volume, but in a few pedons they range to 60 percent.

The A horizon is pale brown, very pale brown, or light yellowish brown.

The Bk horizon is very gravelly loam or very gravelly silt loam. It is very pale brown, pink, light brown, or light yellowish brown. Secondary calcium carbonate consists of films and threads on surfaces of peds, powdery coatings on coarse fragments, or a few small concretions.

The C horizon is very gravelly or gravelly loam or clay loam. It is pink, very pale brown, or light brown.

Tencee Series

The Tencee series consists of soils that are shallow to a petrocalcic horizon. These soils are well drained and moderately permeable and formed in gravelly and loamy materials. They are on convex ridges and knolls. Slopes range from 1 to 8 percent.

Tencee soils are similar to Upton soils and commonly are adjacent to Blakeney, Conger, Lozier, Reagan, Sanderson, and Upton soils on the landscape. Upton soils are less gravelly than and typically are closely associated with Tencee soils. Blakeney and Conger soils are shallow and loamy, have a petrocalcic horizon, have less gravel than Tencee soils, and typically are in positions on the landscape similar to those of Tencee soils. Lozier soils are less than 20 inches deep over limestone bedrock and are on higher slopes. Reagan soils are very deep and lower on the landscape. Sanderson soils are very deep. They are on footslopes.

Typical pedon of Tencee very gravelly loam from an area of Tencee and Upton soils, 1 to 8 percent slopes; from the intersection of U.S. Highway 67 and U.S. Highway 385 in McCamey, 3.6 miles west on Highway 67, 35 yards south of fence for a railroad right-of-way in rangeland:

A—0 to 2 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 4/3) moist; weak fine granular and subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; few fine roots; 35 percent pebbles less than 1 inch in diameter, 20 percent pebbles more than 1 inch in diameter; coarse fragments, mostly limestone, include quartzite, ironstone, and indurated calcium carbonate; fragments cover 75 percent of the surface; calcareous; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk—2 to 11 inches; light yellowish brown (10YR 6/4) very gravelly loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; few fine roots; 40 percent pebbles less than 1 inch in diameter; 15 percent pebbles 1 to 3 inches in diameter; coarse fragments coated with calcium carbonate on the underside; few fine masses of calcium carbonate; violently

effervescent; moderately alkaline; abrupt wavy boundary.

Bkm—11 to 24 inches; pinkish white (7.5YR 8/2) indurated calcium carbonate, pink (7.5YR 8/4) moist; upper 0.25 inch is laminar, smooth, and continuous; embedded limestone, ironstone, and quartzite pebbles; violently effervescent; moderately alkaline; clear wavy boundary.

BCk—24 to 34 inches; very pale brown (10YR 8/3) very gravelly loam, pale brown (10YR 6/3) moist; weak medium granular structure; 35 percent limestone, ironstone, and quartzitic pebbles; 20 percent calcium carbonate concretions and masses of calcium carbonate decreasing with depth; strongly effervescent; moderately alkaline; gradual wavy boundary.

BC—34 to 80 inches; pinkish white (7.5YR 8/2) very gravelly loam, pink (7.5YR 7/4) moist; weak medium granular structure; 35 percent limestone, ironstone, and quartzitic pebbles; strongly effervescent; moderately alkaline.

The A horizon is, by volume, 45 to 60 percent coarse fragments. It is pale brown, light yellowish brown, or very pale brown.

The Bkm horizon is 4 to 30 inches thick. In some pedons, plates 1 or 2 inches thick can be broken out of the upper part of the horizon with a spade. The Bkm horizon is pinkish white or white.

The BCk and BC horizons can have less gravel, ranging from 10 to 55 percent, than the A horizon. They are white, very pale brown, or pinkish white.

Tobosa Series

The Tobosa series consists of very deep, well drained, very slowly permeable soils formed in calcareous clayey materials. These soils are in depressions 3 to 20 feet lower than the surrounding soils. Microdepressions on the soil surface are 6 to 10 feet across and about 25 feet apart. Slopes are less than 1 percent.

Tobosa soils are similar to Ekal soils and are commonly adjacent to Hollomex and Reagan soils on the landscape. The saline Ekal soils are in depressions similar to those of Tobosa soils. Hollomex soils are shallow over gypsiferous materials and are on higher, convex slopes. Reagan soils are very deep, loamy soils on higher, nearly level plains.

Typical pedon of Tobosa clay, 0 to 1 percent slopes, depressional; from the intersection of U.S. Highway 67 and Texas Highway 137 in Big Lake, 12.0 miles north on Texas Highway 137 to intersection with Texas Highway 33, 14.2 miles north on Texas Highway 33, 100 feet east in rangeland:

A—0 to 16 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure with strong medium angular blocky structure in the lower 2 inches; extremely hard, very firm, very sticky, very plastic; few fine roots; few fine pores; dry weather cracks 1 to 2 inches wide; slightly effervescent; moderately alkaline; diffuse wavy boundary.

Bss—16 to 40 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong medium angular blocky structure; wedge-shaped peds, few large intersecting slickensides; extremely hard, very firm, very sticky, very plastic; few fine roots; dry weather cracks 1 inch wide, few specks of calcium carbonate below a depth of 30 inches; strongly effervescent; moderately alkaline; gradual wavy boundary.

BCk—40 to 80 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak medium and coarse angular blocky structure; extremely hard, very firm, very sticky, very plastic; 5 percent masses of calcium carbonate 0.25 to 0.5 inch in diameter; violently effervescent; moderately alkaline.

The solum is 60 to more than 80 inches thick. When these soils are dry, cracks 1 to 3 inches wide extend well into the C horizon. Unplowed areas have gilgai microrelief mostly as small depressions 1 to 15 inches deep and 2 to 12 feet across. The content of clay ranges from 40 to 55 percent. Some pedons have cobbles and stones.

The A horizon is dark grayish brown or grayish brown. Many pedons have a very granular layer on the surface 1 to 2 inches thick.

The Bss and Bkss horizons are grayish brown, brown, or light brownish gray. Calcium carbonate accumulation ranges from a few specks to 10 percent, by volume, in concretions and masses. Some pedons do not have a Bkss horizon.

The BCk horizon is light gray, very pale brown, or pale brown. Calcium carbonate accumulation ranges, by volume, from 5 to 40 percent. In some pedons, hard limestone is below a depth of 60 inches.

Upton Series

The Upton series consists of gravelly soils that are shallow or very shallow over a petrocalcic horizon. These soils are well drained and moderately permeable and formed in loamy, calcareous materials. They are on

convex ridges and knolls. Slopes range from 1 to 8 percent.

Upton soils are similar to Tencee soils and are commonly adjacent to Blakeney, Conger, Lozier, Reagan, Sanderson, and Tencee soils on the landscape. Tencee soils are very gravelly and are closely associated with Upton soils. Blakeney and Conger soils are loamy and have less carbonates than Upton soils. They are in positions on the landscape similar to those of Upton soils. Lozier soils overlie hard limestone bedrock. They are in higher areas on the landscape. Reagan soils are very deep. They are in lower areas on the landscape. Sanderson soils are very deep. They are on footslopes.

Typical pedon of Upton gravelly loam from an area of Tencee and Upton soils, 1 to 8 percent slopes; from the intersection of U.S. Highway 67 and Texas Highway 329 in Rankin, 3.6 miles west on Highway 67, 5.0 miles south on Texas Highway 349, 60 yards west in rangeland:

A—0 to 4 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 4/3) moist; weak fine granular and subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; 15 percent limestone fragments less than 1 inch across; surface crust is weak fine platy; small pebbles cover 25 percent of the surface; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk—4 to 14 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 4/3) moist; weak fine granular and subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; 30 percent indurated calcium carbonate and limestone fragments, most less than 1 inch across, few larger flattened indurated calcium carbonate fragments 12 to 14 inches across; violently effervescent; moderately alkaline; abrupt wavy boundary.

Bkm—14 to 30 inches; white (10YR 8/2) indurated calcium carbonate, light gray (10YR 7/2) moist; continuous, smooth, and laminar in the upper 0.25 inch; violently effervescent; moderately alkaline; gradual wavy boundary.

BCk—30 to 80 inches; white (10YR 8/2) gravelly loam, light gray (10YR 7/2) moist; 20 percent indurated calcium carbonate and limestone fragments; violently effervescent; moderately alkaline.

Depth to the petrocalcic horizon ranges from 7 to 20 inches.

The A horizon is 4 to 12 inches thick. Content of coarse fragments ranges from 15 to 35 percent. Most are limestone fragments less than 1 inch across; some are indurated calcium carbonate. This horizon is light yellowish brown, pale brown, or light brown.

The Bk horizon is 7 to 16 inches thick. Limestone and indurated calcium carbonate fragments range, by volume, from 20 to 35 percent. Most are less than 1 inch across. The Bk horizon is light yellowish brown, very pale brown, pale brown, or light brown.

The Bkm horizon is 4 to 24 inches thick. In most pedons, this horizon is very hard and continuous; however, in some pedons, plates 1 to 2 inches thick can be broken off with a spade.

In the BCk horizon calcium carbonate fragments 0.25 to 3 inches in diameter range from a few to 40 percent of the volume.

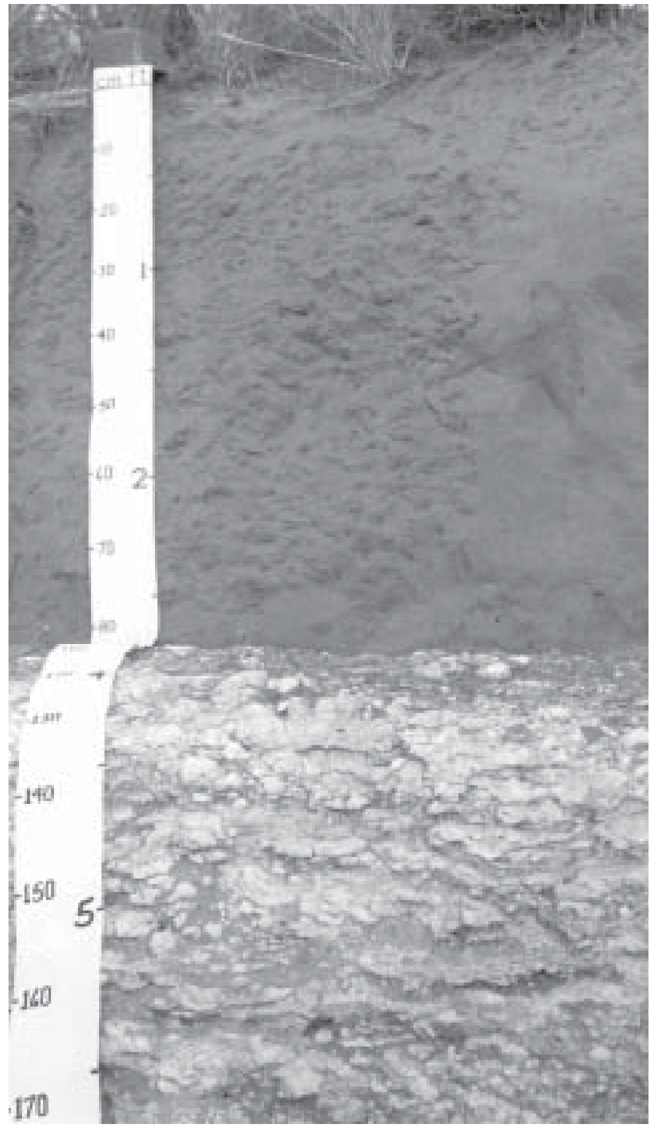

Figure 19.—A profile of Wickett loamy fine sand. This soil has a petrocalcic horizon at a depth of about 33 inches.

Wickett Series

The Wickett series consists of soils that are moderately deep to a petrocalcic horizon (fig. 19). These soils are well drained and moderately rapidly permeable and formed in sandy and loamy eolian materials. Typically, they are on long, nearly level to gently sloping uplands. Slopes range from 0 to 3 percent.

Wickett soils are similar to Pyote soils and commonly are adjacent to Kinco, Penwell, and Pyote soils on the landscape. Pyote soils are deeper than Wickett soils and typically are at slightly higher elevations. Kinco soils are loamy, are deeper than Wickett soils, and typically are at slightly lower elevations. Penwell soils are very deep and sandy. They are higher on the landscape.

Typical pedon of Wickett loamy fine sand, 0 to 3 percent slopes; from the Crane County line, 4.1 miles east on Texas Highway 329, 60 yards north in rangeland:

A—0 to 16 inches; strong brown (7.5YR 5/6) loamy fine sand, strong brown (7.5YR 4/6) moist; weak fine and medium subangular blocky structure; loose, very friable, nonsticky, nonplastic; few fine roots; few wormcasts; slightly effervescent; slightly alkaline; clear wavy boundary.

Bt1—16 to 24 inches; strong brown (7.5YR 5/6) fine sandy loam, reddish brown (5YR 4/4) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable, slightly sticky, nonplastic; few fine roots; clay coatings and bridging of sand grains; few wormcasts; moderately alkaline; gradual wavy boundary.

Bt2—24 to 33 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky, nonplastic; few fine roots; clay coatings and bridging of sand grains; moderately alkaline; abrupt wavy boundary.

Bkm—33 to 49 inches; pinkish white (7.5YR 8/2) indurated calcium carbonate that is smooth and laminar in the upper 0.25 inch; pink (7.5YR 8/4) moist; few calcium carbonate concretions on indurated smooth surface; horizon very difficult to break with a steel bar; violently effervescent; moderately alkaline; clear wavy boundary.

BCk—49 to 80 inches; pinkish white (7.5YR 8/2) gravelly loam, pink (7.5YR 7/4) moist; 15 percent calcium carbonate concretions; violently effervescent; moderately alkaline.

Thickness of the solum to indurated calcium carbonate ranges from 20 to 40 inches.

The A horizon is 8 to 20 inches thick. It is brown, strong brown, or reddish brown. Reaction ranges from neutral to moderately alkaline.

The Bt horizon is 5 to 26 inches thick. In some pedons, a few calcium carbonate concretions are in the lower 3 inches and the pedons are calcareous in the lower part. Reaction is slightly alkaline or moderately alkaline. The Bt horizon is loam or fine sandy loam, and has 3 to 10 percent more clay than the A horizon. It is yellowish red, reddish brown, brown, or strong brown.

The Bkm horizon is 4 to 30 inches thick. Mostly, it is very hard and has few or no fractures.

The BCk horizon is pinkish white, pink, white, or reddish yellow gravelly loam, loam, or fine sandy loam. Some pedons have a few calcium carbonate concretions about 0.25 inch across.

Formation of the Soils

Soil is formed by the action of soil-forming processes on material deposited or accumulated by geological agents. The characteristics of a soil at any given point depend on the physical and mineral composition of the parent material; the climate under which the soil material has accumulated and has existed since it accumulated; the plant and animal life on and in the soil; the relief, or lay of the land; and length of time the forces of soil development have acted on the soil material. All five of these factors are important in the development of every soil, although some have had more influence than others in different locations.

Factors of Soil Formation

Parent Material

Parent material is the unconsolidated mass from which a soil forms. The kind of parent material determines the kind of profile that forms, formation rate, and the soil chemical and mineral composition. Parent material also influences relief and soil geomorphology.

Parent materials in the nearly level northern areas of Reagan and Upton Counties are derived from late Pliocene fluvial sediments that originated in the southern Rocky Mountains. These sediments were strongly calcareous, unconsolidated loam and silty clay loam with quartzose pebbles. Eolian processes subsequently modified these sediments and significantly influenced the kind and location of soil parent materials. A mantle a few feet to 30 feet thick formed over nearly level Lower Cretaceous limestone. Pliocene sediments are also on the broad top of King Mountain, the highest point in the survey area. The major soils that developed from reworked late Pliocene sediments are Reagan, Conger, and Tobosa soils.

The larger intermittent lakes in the survey area are surrounded by gypsiferous and slightly saline soils. Gypsum and other salts were carried into the lakes by surface runoff and then deposited when the water evaporated. Winds transported these minerals to adjacent uplands. The deepest and widest of these eolian deposits are on the north and east sides of the lakes, indicating the prevailing winds were from the southwest. Soils that developed in these areas include Hollomex and Reeves soils.

The sandy parent materials in the western part of Upton County were formed when the Pecos River and the Rio Grande deposited silt and sand near the channels. Southwest winds redeposited these sediments on nearby uplands. This eolian process is ongoing. Soils that developed from these parent materials are Blakeney, Pyote, Kinco, Penwell, and Wickett soils.

Soils in the southern sectors of both counties developed in parent materials weathered from Lower Cretaceous age bedrock and in Quaternary alluvium, both of which are high in calcium carbonate, making all the soils in this area calcareous. Rocks range from hard cryptocrystalline limestone to relatively soft marl. The marl is predominantly calcium carbonate mixed with varying amounts of clay. The alluvium is mostly unconsolidated to poorly cemented fluvial sediment.

Quantity of parent material and soil depth are influenced by the hardness of underlying geologic strata. Hard limestone weathers slowly, limiting available parent material; therefore, Ector, Noelke, and Lozier soils, which formed over hard limestone, are very shallow or shallow. The softer limestone and marl and unconsolidated alluvial and eolian sediments weather more readily than hard limestone. Soils formed over softer strata are deeper than those developed over hard strata. Angelo soils are an example of deeper soils.

Hardness of the parent material influences slope. A thick limestone stratum in the southern sector of the survey area is so resistant to weathering that it provides a protective caprock on many hills. This caprock protects the underlying strata from erosion. Adjacent slopes erode and become steeper. Ector very gravelly loam, 8 to 30 percent slopes, very stony, and Lozier very gravelly loam, 15 to 55 percent slopes, very stony, formed on the steeper slopes. Limestone of intermediate hardness formed landscapes of low, rounded hills. Examples are Ector very gravelly loam, 3 to 8 percent slopes, and Noelke very gravelly silty clay loam, 0 to 5 percent slopes.

Parent material affects soil depth by its influence on water penetration. The parent materials of Pyote soils are dominantly moderately rapidly permeable quartzose sands, which allow water to penetrate to greater depths. Pyote soils developed to a depth of more than 80 inches.

Climate

Climate influences the formation of soils directly through rainfall, evaporation, temperature, and wind. It indirectly influences relief and plant and animal life. Change is more rapid when the soil is moist and warm. Most soil differences in the survey area cannot be attributed to climate alone because climatic differences are not significant.

The low annual rainfall and the high evaporation rate cause an accumulation of minerals in most of the soils. Leaching is minimal. The soils are calcareous throughout except for Blakeney, Pyote, and Penwell soils. All carbonates in Blakeney soils leached from the surface layer into the subsoil, where they became cemented. Most of the carbonates leached out of the Pyote and Penwell soil profiles because of their moderately rapid and rapid permeability, respectively.

Most of the soils have a distinct zone of calcium carbonate accumulation at the normal depth of rain water penetration. In the deeper soils, such as Angelo, Kinco, and Reagan soils, the zone of accumulation is several feet thick and is diffused. In shallow soils, such as Blakeney, Conger, Mereta, Noelke, Tencee, and Upton soils, it is concentrated in narrow bands that became cemented.

The high summer temperatures and the low rainfall limited plant growth and the accumulation of organic matter, causing most of the soils to be light in color. The only soils of dark color in the survey area are Angelo, Ector, Mereta, Noelke, Rioconcho, and Iraan soils. These soils are in the eastern part of the survey area, where the rainfall is highest or where they receive additional water from runoff.

Plant and Animal Life

Plants, micro-organisms, earthworms, insects, and larger animals living in or on the soil contribute to soil formation.

Grasses contribute large amounts of organic matter to the soil, and their fibrous root systems help to keep the soil porous and granular.

Micro-organisms, such as fungi and bacteria, help to decompose organic matter and to break down parent material, thus improving fertility. Burrowing animals, such as ants, earthworms, cicadas, ground squirrels, and badgers, improve soil structure, thereby aiding the movement of water and the growth of plant roots.

The human factor also affects soil formation. Some human activities drastically change soils. Plowing mixes the upper layers, hastens the decay of organic matter, reduces the water intake rate, and bares the soil to wind and water erosion. During construction, soils are excavated, buried, or mixed with other kinds of material. In some areas, they are leveled or made deeper.

Relief

Relief influences soil formation through its effect on drainage, runoff, and erosion. The degree of profile development depends mainly on the amount of moisture in the soil. Nearly level soils absorb more moisture. The hilly and steep Ector and Lozier soils lose much rainfall through runoff. They are shallow or very shallow because little moisture is available for living organisms and because soil is lost through water erosion. The soil erodes almost as fast as it forms. The nearly level Reagan, Angelo, Rioconcho, and Iraan soils are very deep because they absorb greater amounts of water. All except Reagan soils receive runoff from soils at higher elevations. Tobosa soils are very deep because they are in depressions and receive additional water from runoff. The gently sloping Conger and Mereta soils absorb an intermediate amount of water; therefore, they are somewhat deeper than the more sloping Ector and Lozier soils.

Time

A long time is required for the soil-forming factors of climate, plant and animal life, and relief to act upon the parent material.

The first, easily recognized step in soil formation is a darkening of the surface layer caused by the decay of organic matter. At first, only a thin layer darkens and thickens with time. Hollomex and Penwell soils have reached this earlier stage of development. The quartzitic parent material of Penwell soils may be much older than the gypsiferous parent material of Hollomex soils; however, Hollomex and Penwell soils apparently reached the same stage of development because large quartzitic particles in Penwell soils break down very slowly.

The second step is the development of a subsoil. Soil structure begins to form and some chemical changes, such as leaching of bases, begin. Iraan and Rioconcho soils are in this stage of development. In a short time, these soils developed a thick, dark surface layer because they received additional water from runoff. Because the parent material of these soils is recent, there has not been sufficient time to reach the third step.

The third step is the removal of calcium carbonate from the upper layers; the calcium carbonate is then redeposited below as a zone of calcium carbonate accumulation. In early stages, only a small amount of calcium carbonate is visible at the average depth of rain penetration. At later stages, a distinct layer containing some calcium carbonate concretions is visible. Angelo, Reagan, and Kinco soils have reached this stage. In another, more advanced stage, an indurated calcium carbonate layer forms. Blakeney, Conger, Mereta, Tencee, and Upton soils have reached this advanced stage. Indurated layers require a great length of time for development, possibly millions of years.

Another step in soil development occurs after all the free carbonates have been leached from the solum. Carbonates tend to immobilize clay particles; however, after the carbonates are removed, the clay is more easily transported downward by the soil water and is redeposited in the subsoil. The result is a distinct difference in clay content between the surface layer and the subsoil. Pyote and Wickett soils are in this state of development.

References

(1) American Association of State Highway and Transportation Officials. 1986. Standard specifications for highway materials and methods of sampling and testing. Ed. 14, 2 vols.

(2) American Society for Testing and Materials. 1993. Standard classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) Leopold, A. 1966. A Sand County Almanac, with other essays on conservation from Round River. Oxf. Univ. Press., 269 pp., illus.

(4) Ormsby, W. L. 1972. The Butterfield Overland Mail. Huntington Library, San Marino, CA, 179 pp., illus.

(5) Reagan County Historical Survey Committee. 1974. The Reagan County Story. Pioneer Book Publishers, Inc., 275 pp., illus.

(6) Texas Crop and Livestock Reporting Service. 1987. Texas County Statistics. U.S. Dep. Agric. and Tex. Dep. Agric.

(7) United States Department of Agriculture, Soil Conservation Service. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(8) United States Department of Agriculture, Soil Conservation Service. 1984. Procedures for collecting soil samples and methods of analysis for soil survey. Soil Surv. Invest. Rep. I, 68 pp., illus.

(9) United States Department of Agriculture, Soil Conservation Service. 1993. Soil survey manual. Soil Surv. Staff, U.S. Dep. Agric. Handb. 18.

Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds directly beneath the solum, or it is exposed at the surface by erosion.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the “Soil Survey Manual.”

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the "Soil Survey Manual."

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A

horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity,

consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash plain. A landform of mainly sandy or coarse-textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as “saturated hydraulic conductivity,” which is defined in the “Soil Survey Manual.” In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as “permeability.” Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to

pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance and a 100 percent slope is a 45 degree slope. In this survey, classes for simple slopes are as follows:

Nearly level	0 to 1 percent
Very gently sloping	1 to 3 percent
Gently sloping	3 to 5 percent
Moderately sloping	5 to 8 percent
Strongly sloping	8 to 12 percent
Moderately steep	12 to 20 percent
Steep	20 to 45 percent
Very steep	45 percent and higher

Classes for complex slopes are as follows:

Nearly level	0 to 3 percent
Gently undulating	1 to 5 percent
Undulating	5 to 8 percent
Rolling	5 to 10 percent
Hilly	10 to 30 percent
Steep	20 to 45 percent
Very steep	45 percent and higher

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging

between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Surface layer. Technically, the A horizon in mineral soils. Generally refers to the uppermost mineral layer of soil. Includes the Ap horizon or "plow layer."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Tables

Table 1.--Temperature and Precipitation

(Recorded in the period 1964-90 at Big Lake, Texas, and in the period 1961-90 at McCamey, Texas)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	^{o}F	^{o}F	^{o}F	^{o}F	^{o}F	Units	In	In	In		In
Big Lake:											
January----	57.1	28.7	42.9	80	9	38	0.54	0.17	0.97	1	0.8
February---	61.1	31.9	46.5	84	13	60	0.90	0.24	1.49	2	0.1
March------	69.8	40.8	55.3	90	16	219	0.92	0.19	1.70	2	0.0
April------	79.0	50.5	64.8	95	30	446	1.49	0.58	2.36	2	0.0
May--------	85.6	58.1	71.8	101	39	673	2.49	1.02	3.74	4	0.0
June-------	91.4	65.2	78.3	104	50	850	1.72	0.84	2.60	3	0.0
July-------	94.0	67.3	80.6	103	58	946	2.07	0.31	3.39	3	0.0
August-----	93.2	65.8	79.5	104	57	912	1.99	0.58	3.27	3	0.0
September--	86.4	60.0	73.2	100	41	695	3.28	0.84	5.22	4	0.0
October----	77.3	49.8	63.6	94	32	422	2.27	0.60	3.75	3	0.0
November---	67.3	39.4	53.3	86	18	174	0.99	0.27	1.94	1	0.4
December---	58.6	30.0	44.3	79	10	40	0.74	0.20	1.46	1	0.0
Yearly:	76.7	49.0	62.8	---	---	5,476	19.40	12.88	24.35	29	1.3
McCamey:											
January----	59.3	30.6	45.0	82	9	49	0.38	0.10	0.70	1	0.6
February---	64.5	34.9	49.7	85	14	97	0.59	0.16	1.00	1	0.3
March------	73.4	43.4	58.4	93	20	292	0.40	0.11	0.81	1	0.1
April------	82.6	53.2	67.9	98	33	541	0.89	0.23	1.65	1	0.0
May--------	89.1	61.0	75.0	104	43	767	1.73	0.61	2.66	2	0.0
June-------	94.0	68.7	81.4	106	54	941	1.53	0.48	2.48	2	0.0
July-------	95.3	71.6	83.5	105	63	1,038	0.99	0.26	1.63	1	0.0
August-----	94.9	70.6	82.8	105	62	1,016	1.60	0.35	2.58	2	0.0
September--	88.2	64.7	76.5	101	47	791	2.76	0.66	4.42	4	0.0
October----	79.6	53.9	66.8	96	34	522	2.17	0.45	3.92	2	0.1
November---	68.7	42.2	55.5	87	22	213	0.69	0.20	1.33	1	0.4
December---	60.9	32.8	46.9	82	13	63	0.57	0.12	1.06	1	0.0
Yearly:	79.2	52.3	65.8	---	---	6,331	14.29	9.73	18.39	19	1.4

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

Table 2.--Freeze Dates in Spring and Fall

(Recorded in the period 1964-90 at Big Lake, Texas)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	March 29	April 3	April 11
2 years in 10 later than--	March 20	March 29	April 5
5 years in 10 later than--	March 4	March 20	March 27
First freezing temperature in fall:			
1 year in 10 earlier than--	November 3	October 26	October 15
2 years in 10 earlier than--	November 9	November 1	October 23
5 years in 10 earlier than--	November 20	November 13	November 5

Table 3.--Growing Season

(Recorded in the period 1964-90 at Big Lake, Texas)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	231	214	202
8 years in 10	239	221	209
5 years in 10	255	234	223
2 years in 10	271	247	236
1 year in 10	279	254	243

Table 4.--Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Reagan County Acres	Upton County Acres	Total Area Acres	Total Extent Percent
AnA	Angelo silty clay loam, 0 to 1 percent slopes	42,720	0	42,720	2.8
AnB	Angelo silty clay loam, 1 to 3 percent slopes	31,490	0	31,490	2.0
BKB	Blakeney fine sandy loam, 1 to 3 percent slopes	0	1,870	1,870	0.1
CrB	Conger-Reagan association, 0 to 3 percent slopes	145,830	92,100	237,930	15.4
ECC	Ector very gravelly loam, 3 to 8 percent slopes	63,060	2,840	65,900	4.3
ECE	Ector very gravelly loam, 8 to 30 percent slopes, very stony	8,610	8,680	17,290	1.1
EKA	Ekal clay, 0 to 1 percent slopes, depressional	2,130	0	2,130	0.1
HMC	Hollomex loam, 1 to 8 percent slopes	1,670	1,790	3,460	0.2
Ir	Iraan silty clay loam, occasionally flooded	2,940	16,780	19,720	1.3
KNB	Kinco fine sandy loam, 0 to 2 percent slopes	0	15,240	15,240	1.0
LZD	Lozier very gravelly loam, 2 to 15 percent slopes	0	57,530	57,530	3.7
LZG	Lozier very gravelly loam, 15 to 55 percent slopes, very stony	0	24,970	24,970	1.6
MeA	Mereta clay loam, 0 to 1 percent slopes	2,170	0	2,170	0.1
MeB	Mereta clay loam, 1 to 3 percent slopes	2,830	0	2,830	0.2
NKC	Noelke very gravelly silty clay loam, 0 to 5 percent slopes	9,460	0	9,460	0.6
OW	Oil-waste land	1,980	350	2,330	0.1
PWC	Penwell fine sand, undulating	0	1,110	1,110	0.1
PYB	Pyote loamy fine sand, 0 to 3 percent slopes	0	2,840	2,840	0.2
RaA	Reagan loam, 0 to 1 percent slopes	302,834	358,690	661,524	42.7
RaB	Reagan loam, 1 to 3 percent slopes	104,570	119,650	224,220	14.5
REB	Reeves loam, 0 to 5 percent slopes	3,100	990	4,090	0.3
Ro	Rioconcho silty clay loam, occasionally flooded	15,510	0	15,510	1.0
SAC	Sanderson very gravelly loam, 1 to 8 percent slopes	4,070	15,674	19,744	1.3
TEC	Tencee and Upton soils, 1 to 8 percent slopes	110	67,540	67,650	4.4
TOA	Tobosa clay, 0 to 1 percent slopes, depressional	7,530	3,010	10,540	0.7
WKB	Wickett loamy fine sand, 0 to 3 percent slopes	0	3,930	3,930	0.2
	Total	752,614	795,584	1,548,198	100.0

Table 5.--Rangeland Productivity

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
AnA, AnB----------------- Angelo	Clay Loam-----------------------------	3,200	2,600	1,900
BKB---------------------- Blakeney	Shallow-------------------------------	2,000	1,500	1,000
CrB*:				
Conger------------------	Shallow-------------------------------	2,000	1,500	1,000
Reagan------------------	Loamy---------------------------------	1,800	1,200	600
ECC---------------------- Ector	Limestone Hill------------------------	1,500	1,000	750
ECE---------------------- Ector	Steep Rocky---------------------------	1,250	950	675
EKA---------------------- Ekal	Saline Lakebed------------------------	3,500	2,500	1,500
HMC---------------------- Hollomex	Gyp-----------------------------------	900	600	350
Ir----------------------- Iraan	Draw----------------------------------	1,600	1,150	900
KNB---------------------- Kinco	Sandy Loam----------------------------	1,500	1,200	600
LZD---------------------- Lozier	Limestone Hill------------------------	1,500	1,000	750
LZG---------------------- Lozier	Steep Rocky---------------------------	1,250	950	675
MeA, MeB----------------- Mereta	Shallow-------------------------------	2,000	1,500	1,000
NKC---------------------- Noelke	Limestone Hill------------------------	1,500	1,000	750
PWC---------------------- Penwell	Sandhills-----------------------------	2,400	1,750	1,200
PYB---------------------- Pyote	Loamy Sand----------------------------	2,000	1,500	1,000
RaA, RaB----------------- Reagan	Loamy---------------------------------	1,800	1,200	600
REB---------------------- Reeves	Loamy---------------------------------	1,800	1,200	600
Ro----------------------- Rioconcho	Loamy Bottomland----------------------	3,000	2,200	1,000
SAC---------------------- Sanderson	Gravelly------------------------------	1,000	950	300

See footnote at end of table.

Table 5.--Rangeland Productivity--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
TEC*:				
Tencee	Very Shallow	800	550	250
Upton	Very Shallow	500	350	200
TOA Tobosa	Clay Flat	2,700	2,150	1,450
WKB Wickett	Loamy Sand	1,700	1,250	800

*See description of the map unit for composition and behavior characteristics of the map unit.

Table 6.--Recreational Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AnA------------------- Angelo	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
AnB------------------- Angelo	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
BKB------------------- Blakeney	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight----------	Severe: cemented pan.
CrB*:					
Conger---------------	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Moderate: dusty.	Severe: cemented pan.
Reagan---------------	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.
ECC------------------- Ector	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones.	Moderate: large stones.	Severe: small stones, large stones, thin layer.
ECE------------------- Ector	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: large stones, slope.	Moderate: large stones, slope.	Severe: small stones, large stones, slope.
EKA------------------- Ekal	Severe: wetness, percs slowly, too clayey.	Severe: too clayey, excess salt, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: too clayey.	Severe: excess salt, droughty, too clayey.
HMC------------------- Hollomex	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.	Slight.
Ir-------------------- Iraan	Severe: flooding.	Slight----------	Moderate: small stones, flooding.	Slight----------	Moderate: flooding.
KNB------------------- Kinco	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: droughty.
LZD------------------- Lozier	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.	Severe: small stones, depth to rock.
LZG------------------- Lozier	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: large stones, slope.	Severe: slope, small stones.	Severe: small stones, slope, thin layer.
MeA, MeB-------------- Mereta	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight----------	Severe: cemented pan.

See footnote at end of table.

Table 6.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
NKC------------------- Noelke	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones.	Severe: small stones.	Severe: small stones, thin layer.
OW*------------------- Oil-waste land	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight----------	Severe: excess salt.
PWC------------------- Penwell	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
PYB------------------- Pyote	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Severe: droughty.
RaA------------------- Reagan	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.
RaB------------------- Reagan	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.	Slight.
REB------------------- Reeves	Moderate: dusty, excess salt.	Moderate: excess salt, dusty.	Moderate: slope, dusty.	Severe: erodes easily.	Moderate: excess salt, droughty.
Ro-------------------- Rioconcho	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
SAC------------------- Sanderson	Severe: small stones.	Severe: small stones.	Severe: small stones, slope.	Severe: small stones.	Severe: small stones.
TEC*:					
Tencee---------------	Severe: small stones, cemented pan.	Severe: small stones, cemented pan.	Severe: small stones, cemented pan.	Severe: small stones.	Severe: small stones, cemented pan.
Upton----------------	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Moderate: dusty.	Severe: cemented pan.
TOA------------------- Tobosa	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, too clayey.
WKB------------------- Wickett	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: droughty, cemented pan.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 7.--Building Site Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AnA, AnB: Angelo	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
BKB: Blakeney	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.
CrB*:						
Conger	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.
Reagan	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
ECC: Ector	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: small stones, large stones.
ECE: Ector	Severe: depth to rock, slope.	Severe: slope, depth to rock	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, slope, thin layer.
EKA: Ekal	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Severe: excess salt, droughty, too clayey.
HMC: Hollomex	Slight	Slight	Slight	Moderate: slope.	Slight	Slight.
Ir: Iraan	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
KNB: Kinco	Slight	Slight	Slight	Slight	Slight	Moderate: droughty.
LZD: Lozier	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.
LZG: Lozier	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, slope, depth to rock.
MeA, MeB: Mereta	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: low strength.	Severe: cemented pan.

See footnote at end of table.

Table 7.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
NKC------------- Noelke	Severe: depth to rock, cemented pan.	Severe: depth to rock.	Severe: depth to rock, cemented pan.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, thin layer.
OW*------------- Oil-waste land	Variable-------	Variable-------	Variable-------	Variable-------	Variable-------	Severe: excess salt.
PWC------------- Penwell	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: droughty.
PYB------------- Pyote	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
RaA, RaB--------- Reagan	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
REB------------- Reeves	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Moderate: excess salt, droughty.
Ro--------------- Rioconcho	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: flooding.
SAC------------- Sanderson	Slight---------	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: small stones.
TEC*:						
Tencee-----------	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.
Upton------------	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan.	Moderate: cemented pan.	Severe: droughty, cemented pan.
TOA------------- Tobosa	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
WKB------------- Wickett	Moderate: cemented pan.	Slight---------	Moderate: cemented pan.	Slight---------	Slight---------	Moderate: droughty, cemented pan.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 8.--Sanitary Facilities

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AnA: Angelo	Severe: percs slowly.	Moderate: seepage.	Slight	Slight	Slight.
AnB: Angelo	Severe: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Slight.
BKB: Blakeney	Severe: cemented pan.	Severe: seepage, cemented pan.	Moderate: cemented pan.	Slight	Poor: cemented pan.
CrB*:					
Conger	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Slight	Poor: cemented pan.
Reagan	Slight	Moderate: seepage.	Slight	Slight	Good.
ECC: Ector	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim.
ECE: Ector	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
EKA: Ekal	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness, too clayey,	Severe: wetness.	Poor: too clayey, hard to pack,
HMC: Hollomex	Slight	Slight	Slight	Slight	Poor: thin layer.
Ir: Iraan	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey.
KNB: Kinco	Slight	Severe: seepage.	Slight	Slight	Good.
LZD: Lozier	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
LZG: Lozier	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
MeA, MeB: Mereta	Severe: cemented pan.	Severe: cemented pan.	Moderate: too clayey, cemented pan.	Severe: cemented pan.	Poor: cemented pan, too clayey, hard to pack.

See footnote at end of table.

Table 8.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
NKC----------------- Noelke	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock.	Severe: depth to rock, cemented pan.	Poor: area reclaim.
OW*----------------- Oil-waste land	Variable---------	Variable---------	Severe: excess salt.	Variable---------	Severe: excess salt.
PWC----------------- Penwell	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: seepage, too sandy.
PYB----------------- Pyote	Severe: poor filter.	Severe: seepage.	Moderate: too sandy.	Slight-----------	Poor: seepage.
RaA----------------- Reagan	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Good.
RaB----------------- Reagan	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
REB----------------- Reeves	Severe: excess gypsum.	Severe: excess gypsum.	Slight-----------	Slight-----------	Good.
Ro------------------ Rioconcho	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
SAC----------------- Sanderson	Moderate: percs slowly.	Moderate: seepage, slope, large stones.	Moderate: large stones.	Slight-----------	Poor: small stones.
TEC*:					
Tencee-------------	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Poor: cemented pan.
Upton--------------	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Slight-----------	Poor: cemented pan, small stones.
TOA----------------- Tobosa	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
WKB----------------- Wickett	Severe: cemented pan.	Severe: seepage, cemented pan.	Moderate: cemented pan.	Slight-----------	Poor: cemented pan.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 9.--Construction Materials

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AnA, AnB-------------- Angelo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BKB------------------- Blakeney	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones.
CrB*:				
Conger---------------	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan.
Reagan---------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
ECC------------------- Ector	Poor: area reclaim, depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
ECE------------------- Ector	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
EKA------------------- Ekal	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
HMC------------------- Hollomex	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ir-------------------- Iraan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
KNB------------------- Kinco	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
LZD------------------- Lozier	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
LZG------------------- Lozier	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
MeA, MeB-------------- Mereta	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, too clayey.
NKC------------------- Noelke	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
OW*------------------- Oil-waste land	Severe: area reclaim.	Severe: excess fines.	Severe: excess fines.	Severe: excess salt.

See footnote at end of table.

Table 9.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
PWC-------------------Penwell	Good	Probable	Improbable: too sandy.	Poor: too sandy.
PYB-------------------Pyote	Good	Probable	Improbable: too sandy.	Fair: too sandy.
RaA, RaB--------------Reagan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
REB-------------------Reeves	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, excess salt.
Ro--------------------Rioconcho	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
SAC-------------------Sanderson	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
TEC*:				
Tencee----------------	Poor: cemented pan.	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones.
Upton-----------------	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones, area reclaim.
TOA-------------------Tobosa	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
WKB-------------------Wickett	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: cemented pan, thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 10.--Water Management

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes and levees	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
AnA, AnB Angelo	Moderate: seepage.	Slight	Favorable	Favorable	Too arid.
BKB Blakeney	Severe: seepage, cemented pan.	Severe: piping.	Droughty	Cemented pan	Too arid, droughty.
CrB*:					
Conger	Severe: cemented pan.	Severe: piping.	Cemented pan	Cemented pan, erodes easily.	Too arid, erodes easily, cemented pan.
Reagan	Moderate: seepage.	Slight	Erodes easily	Erodes easily	Too arid, erodes easily.
ECC Ector	Severe: depth to rock.	Severe: large stones.	Slope, large stones, droughty.	Large stones, depth to rock.	Large stones, droughty.
ECE Ector	Severe: depth to rock.	Severe: thin layer, large stones.	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
EKA Ekal	Moderate: seepage.	Severe: hard to pack, excess salt.	Wetness, droughty, slow intake.	Erodes easily, wetness, percs slowly.	Wetness, excess salt, erodes easily.
HMC Hollomex	Severe: seepage.	Severe: thin layer.	Slope	Erodes easily	Too arid, erodes easily.
Ir Iraan	Slight	Slight	Flooding	Favorable	Favorable.
KNB Kinco	Severe: seepage.	Severe: piping.	Droughty, soil blowing.	Soil blowing	Too arid, droughty.
LZD Lozier	Severe: depth to rock.	Severe: thin layer.	Slope, droughty, depth to rock.	Slope, large stones, depth to rock.	Too arid, large stones, slope.
LZG Lozier	Severe: depth to rock, slope.	Severe: thin layer.	Slope, droughty.	Slope, large stones, depth to rock.	Too arid, large stones, slope.
MeA, MeB Mereta	Severe: cemented pan, seepage.	Severe: thin layer.	Cemented pan	Cemented pan	Cemented pan.
NKC Noelke	Severe: depth to rock, cemented pan.	Slight	Droughty, depth to rock.	Depth to rock, cemented pan.	Droughty, depth to rock.
OW* Oil-waste land	Variable	Severe: excess salt.	Excess salt	Variable	Excess salt.

See footnote at end of table.

Table 10.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes and levees	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
PWC: Penwell	Severe: seepage.	Severe: seepage, piping.	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
PYB: Pyote	Severe: seepage.	Severe: seepage, piping.	Droughty, fast intake.	Soil blowing	Too arid, droughty.
RaA, RaB: Reagan	Moderate: seepage.	Slight	Erodes easily	Erodes easily	Too arid, erodes easily.
REB: Reeves	Severe: excess gypsum, seepage.	Severe: excess gypsum.	Excess gypsum, excess salt.	Excess gypsum, erodes easily.	Too arid, excess salt.
Ro: Rioconcho	Slight	Severe: hard to pack.	Percs slowly	Percs slowly	Percs slowly.
SAC: Sanderson	Moderate: seepage, slope.	Moderate: large stones.	Slope, droughty.	Large stones	Too arid, large stones, droughty.
TEC*:					
Tencee	Severe: cemented pan.	Severe: thin layer.	Droughty, cemented pan, slope.	Cemented pan	Droughty, cemented pan.
Upton	Severe: cemented pan.	Slight	Slope, droughty, cemented pan.	Cemented pan	Too arid, droughty.
TOA: Tobosa	Slight	Severe: hard to pack, ponding.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
WKB: Wickett	Severe: seepage.	Severe: seepage, piping.	Droughty, fast intake, soil blowing.	Cemented pan, soil blowing.	Too arid, droughty, cemented pan.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 11.--Engineering Index Properties

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
AnA, AnB--------- Angelo	0-11	Silty clay loam--	CL	A-6, A-7-6	0	90-100	90-100	85-100	60-90	37-50	18-30
	11-30	Clay, silty clay loam, silty clay.	CL, CH	A-6, A-7-6	0	90-100	90-100	85-100	70-92	37-60	20-38
	30-80	Clay loam, silty clay loam, clay.	CL	A-6, A-7-6	0	60-100	60-100	60-100	50-90	30-49	15-30
BKB-------------- Blakeney	0-14	Fine sandy loam--	SC, SC-SM	A-4, A-2-4	0-5	80-95	75-95	60-80	30-50	18-27	4-10
	14-25	Indurated--------	---	---	---	---	---	---	---	---	---
	25-80	Fine sandy loam, loam, gravelly loam.	SC, SC-SM, CL, CL-ML	A-2, A-4, A-6	5-20	75-95	70-90	55-85	25-55	15-25	4-12
CrB*:											
Conger----------	0-15	Loam------------	CL, CL-ML, SC, SC-SM	A-4, A-6	0-5	90-100	90-100	75-95	40-65	20-35	5-15
	15-21	Indurated--------	---	---	---	---	---	---	---	---	---
	21-80	Loam, gravelly loam, clay loam.	CL, CL-ML, SC, SC-SM, SM	A-4, A-6, A-2-4	5-15	80-95	75-90	60-85	45-70	20-40	5-22
Reagan----------	0-8	Loam------------	CL	A-6	0	95-100	95-100	85-100	65-90	30-40	14-22
	8-30	Loam, clay loam, clay.	CL	A-6, A-7-6	0	95-100	93-100	80-100	75-95	35-50	18-30
	30-80	Loam, clay loam, clay.	CL	A-6, A-7-6	0	95-100	90-100	80-100	75-95	35-50	18-30
ECC-------------- Ector	0-6	Very gravelly loam.	SC, GC, CL, CL-ML	A-2, A-4, A-6	5-35	40-75	40-65	35-60	30-55	20-40	5-22
	6-14	Very cobbly loam, extremely cobbly loam, extremely cobbly clay loam.	GC, GM-GC, GP-GC	A-2, A-4, A-1-A, A-6	50-75	25-55	15-50	15-50	10-40	20-40	5-22
	14-80	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
ECE-------------- Ector	0-14	Very stony loam--	CL, CH, SC, GC	A-2, A-7	15-50	40-75	40-65	35-60	30-55	25-44	8-22
	14-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
EKA-------------- Ekal	0-15	Clay------------	CH	A-7-6	0	100	100	85-100	75-100	56-70	33-44
	15-48	Clay, silty clay-	CH	A-7-6	0	100	100	85-100	75-100	56-70	33-44
	48-80	Clay loam--------	CL	A-7-6, A-6	0	100	100	90-100	70-85	35-48	15-25
HMC-------------- Hollomex	0-10	Loam------------	ML, CL-ML	A-4	0	100	100	85-95	65-75	15-25	NP-10
	10-60	Gypsiferous material.	---	---	---	---	---	---	---	---	---
Ir--------------- Iraan	0-25	Silty clay loam--	CL	A-6, A-7-6	0-3	95-100	75-100	70-99	55-80	35-50	18-30
	25-80	Silty clay loam, clay loam, silty clay.	CL	A-6, A-7-6	0-8	90-100	75-100	70-98	55-95	35-50	18-30

See footnote at end of table.

Table 11.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
KNB-------------- Kinco	0-12	Fine sandy loam--	SM, SC-SM, CL-ML, ML	A-2-4, A-4	0	98-100	95-100	80-98	25-55	18-25	2-7
	12-33	Fine sandy loam, loam.	SM, SC-SM, CL-ML, ML	A-2-4, A-4	0	80-100	80-100	75-95	30-65	18-26	1-8
	33-60	Loam, fine sandy loam.	SM, SC-SM, CL-ML, ML	A-2-4, A-4	0	90-100	90-100	80-98	30-65	18-28	1-9
	60-80	Loam, fine sandy loam.	SM, SC-SM, CL-ML, ML	A-2-4, A-4	0	90-100	90-100	80-98	30-65	18-28	1-9
LZD-------------- Lozier	0-12	Very gravelly loam.	GC	A-2, A-4, A-6, A-7	5-20	30-60	25-55	20-50	15-45	25-48	8-26
	12-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
LZG-------------- Lozier	0-12	Very stony loam--	GC, SC, CL	A-2, A-4, A-6, A-7-6	0-25	35-70	30-70	25-65	20-55	25-48	8-26
	12-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
MeA, MeB--------- Mereta	0-5	Clay loam--------	CL	A-6, A-7-6	0-5	90-100	85-100	80-97	60-85	39-50	19-28
	5-18	Clay loam, silty clay, clay.	CL, CH	A-6, A-7-6	0-5	90-100	85-100	80-97	60-85	39-52	19-30
	18-25	Indurated--------	---	---	---	---	---	---	---	---	---
	25-80	Variable, marl---	CL, CL-MC, SC, SC-SM, SM	A-4,A-6, A-2-4	5-15	75-95	75-95	60-85	45-70	20-40	5-22
NKC-------------- Noelke	0-12	Very gravelly silty clay loam.	SC, GC	A-2, A-7-6, A-6	0-10	45-80	30-60	25-50	15-40	35-55	20-35
	12-15	Indurated--------	---	---	---	---	---	---	---	---	---
	15-80	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
OW*-------------- Oil-waste land	0-80	Variable---------	---	---	---	---	---	---	---	---	---
PWC-------------- Penwell	0-15	Fine sand--------	SM, SP-SM, SP	A-2-4, A-3	0	100	98-100	70-100	2-25	<22	NP-3
	15-80	Fine sand, loamy fine sand.	SM, SP, SP-SM	A-2-4, A-3	0	100	98-100	70-100	2-30	<22	NP-3
PYB-------------- Pyote	0-24	Loamy fine sand--	SM, SP-SM	A-2-4, A-3	0	100	100	95-100	5-25	<22	NP-3
	24-60	Fine sandy loam--	SM, SC-SM, SP-SM	A-2-4	0	100	100	95-100	10-30	<25	NP-7
	60-80	Loamy fine sand, fine sandy loam, gravelly fine sandy loam.	SM, SP-SM, SP-SM	A-2	0	75-100	50-95	40-90	10-30	<22	NP-7
RaA, RaB--------- Reagan	0-8	Loam-------------	CL	A-6	0	95-100	95-100	85-100	65-90	30-40	14-22
	8-30	Loam, clay loam, clay.	CL	A-6, A-7-6	0	95-100	93-100	80-100	75-95	35-50	18-30
	30-80	Loam, clay loam, clay.	CL	A-6, A-7-6	0	95-100	90-100	80-100	75-95	35-50	18-30

See footnote at end of table.

Table 11.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
REB------------- Reeves	0-16	Loam------------	CL	A-6	0	100	100	75-90	60-80	25-35	10-15
	16-22	Loam, clay loam, silt loam.	CL	A-6	0	100	100	75-100	65-80	25-35	10-15
	22-80	Gypsiferous material.	---	---	---	---	---	---	---	---	---
Ro-------------- Rioconcho	0-30	Silty clay loam--	CL, CH	A-6, A-7-6	0-5	85-100	83-100	75-100	70-99	35-55	20-35
	30-80	Clay, silty clay, clay loam.	CL, CH	A-7-6, A-6	0-5	85-100	83-100	75-100	70-99	35-70	20-45
SAC------------- Sanderson	0-12	Very gravelly loam.	GC, GM-GC, SC, SC-SM	A-2, A-4, A-6, A-1-B	0-25	30-80	20-70	15-65	13-50	22-40	5-20
	12-80	Very gravelly loam, very gravelly clay loam, very gravelly sandy loam.	GC, GM-GC, SC, SC-SM	A-2, A-4, A-6, A-1-B	0-25	30-80	20-70	15-65	13-50	22-40	5-20
TEC*:											
Tencee----------	0-11	Very gravelly loam.	GM-GC	A-2	10-15	35-60	30-55	25-40	20-35	25-30	5-10
	11-24	Indurated--------	---	---	---	---	---	---	---	---	---
	24-80	Variable---------	SP-SC, GC, SC, GP-GC	A-2, A-4, A-6	5-15	30-85	20-75	10-70	5-45	25-40	8-20
Upton-----------	0-4	Gravelly loam----	CL, GC, SC	A-4, A-6	0-2	65-85	60-75	51-70	36-55	25-40	8-20
	4-14	Gravelly loam, gravelly clay loam, gravelly sandy loam.	CL, GC, SC	A-4, A-6	0-2	65-95	60-90	51-85	41-71	25-40	8-20
	14-30	Indurated--------	---	---	---	---	---	---	---	---	---
	30-80	Gravelly loam, extremely gravelly loam, very gravelly loam.	SP-SC, GC, SC, GP-GC	A-2, A-4, A-6	0-20	30-85	20-75	10-70	5-45	25-40	8-20
TOA------------- Tobosa	0-16	Clay-------------	CH	A-7-6	0-2	98-100	97-100	90-100	85-98	51-70	30-45
	16-40	Clay, silty clay	CH	A-7-6	0-2	98-100	96-100	90-100	85-98	55-72	35-48
	40-80	Clay, silty clay	CH, CL	A-7-6	0-2	96-100	95-100	90-100	80-95	45-65	30-45
WKB------------- Wickett	0-16	Loamy fine sand--	SM, SP-SM	A-2-4	0	100	98-100	75-98	10-25	<22	NP-4
	16-33	Fine sandy loam, loam.	SM, SC-SM	A-2-4, A-4	0	100	98-100	80-98	13-40	15-22	2-7
	33-49	Indurated--------	---	---	---	---	---	---	---	---	---
	49-80	Loamy fine sand, fine sandy loam, gravelly loam.	SM, SC-SM, GM, GM-GC	A-4	0-5	70-100	50-100	45-90	35-65	15-22	2-7

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 12.--Physical and Chemical Properties of the Soils

(The symbol < means less than; > means more than. Entries under "Erosion factors—T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm					Pct
AnA, AnB---------Angelo	0-11	30-40	1.25-1.45	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate--	0.32	4	4	1-4
	11-30	35-50	1.35-1.55	0.2-0.6	0.14-0.20	7.9-8.4	<2	High------	0.32			
	30-80	30-45	1.40-1.60	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate--	0.32			
BKB-------------Blakeney	0-14	8-18	1.35-1.55	2.0-6.0	0.08-0.14	7.9-8.4	<2	Low-------	0.24	1	3	.5-2
	14-25	---	---	0.01-0.6	---	---	---	----------	----			
	25-80	8-18	1.45-1.65	2.0-6.0	0.05-0.12	7.9-8.4	<2	Low-------	0.15			
CrB*:												
Conger----------	0-15	18-27	1.30-1.50	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low-------	0.37	1	4L	1-2
	15-21	---	---	0.01-0.6	---	---	---	----------	----			
	21-80	20-35	1.35-1.55	0.6-2.0	0.06-0.10	7.9-8.4	<2	Low-------	0.20			
Reagan----------	0-8	18-27	1.35-1.50	0.6-2.0	0.15-0.20	7.9-8.4	<2	Moderate--	0.37	5	7	.5-2
	8-30	20-45	1.35-1.50	0.6-2.0	0.10-0.16	7.9-8.4	0-4	Moderate--	0.32			
	30-80	25-45	1.45-1.65	0.6-2.0	0.10-0.16	7.9-8.4	0-4	Moderate--	0.32			
ECC-------------Ector	0-6	20-35	1.30-1.55	0.6-2.0	0.05-0.10	7.9-8.4	<2	Low-------	0.10	1	8	1-3
	6-14	20-35	1.30-1.55	0.6-2.0	0.02-0.06	7.9-8.4	<2	Low-------	0.10			
	14-80	---	---	0.06-2.0	---	---	---	----------	----			
ECE-------------Ector	0-14	20-35	1.30-1.45	0.6-2.0	0.04-0.10	7.9-8.4	<2	Low-------	0.10	1	8	1-3
	14-30	---	---	---	---	---	---	----------	----			
EKA-------------Ekal	0-15	40-55	1.40-1.50	<0.06	0.07-0.13	7.4-8.4	8-16	High------	0.37	5	4	1-3
	15-48	40-55	1.40-1.55	<0.06	0.01-0.10	7.4-8.4	>16	High------	0.37			
	48-80	27-40	1.40-1.65	0.06-2.0	0.01-0.05	7.4-8.4	>16	Moderate--	0.28			
HMC-------------Hollomex	0-10	10-15	1.40-1.50	0.6-2.0	0.16-0.18	7.4-8.4	2-4	Low-------	0.37	5	4L	.7-1
	10-60	---	---	---	---	---	---	----------	----			
Ir--------------Iraan	0-25	27-40	1.15-1.25	0.2-0.6	0.15-0.22	7.9-8.4	0-2	Moderate--	0.32	5	4L	1-3
	25-80	30-45	1.20-1.35	0.2-0.6	0.14-0.22	7.9-8.4	0-2	Moderate--	0.32			
KNB-------------Kinco	0-12	10-18	1.25-1.45	2.0-6.0	0.10-0.14	7.9-8.4	<2	Low-------	0.24	5	3	.5-1
	12-33	10-18	1.25-1.45	2.0-6.0	0.08-0.12	7.9-8.4	<2	Low-------	0.28			
	33-60	10-18	1.25-1.45	2.0-6.0	0.08-0.14	7.9-8.4	<2	Low-------	0.28			
	60-80	10-18	1.25-1.45	2.0-6.0	0.08-0.14	7.9-8.4	<2	Low-------	0.28			
LZD, LZG---------Lozier	0-12	15-35	1.30-1.50	0.6-2.0	0.05-0.10	7.9-8.4	<2	Low-------	0.10	1	8	1-4
	12-60	---	---	0.06-2.0	---	---	---	----------	----			
MeA, MeB---------Mereta	0-5	35-40	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate--	0.32	1	4	1-2
	5-18	35-45	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate--	0.32			
	18-25	---	---	0.01-0.6	---	---	---	----------	----			
	25-80	---	---	0.06-2.0	---	---	---	----------	----			
NKC-------------Noelke	0-12	28-45	1.30-1.50	0.6-2.0	0.05-0.12	7.9-8.4	<2	Moderate--	0.10	1	8	1-3
	12-15	---	---	0.01-0.6	---	---	---	----------	----			
	15-80	---	---	0.2-2.0	---	---	---	----------	----			
OW*-------------Oil-waste land	0-80	---	---	0.01-20	---	---	>8	----------	----	---	---	---

See footnote at end of table.

Table 12.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm					Pct
PWC: Penwell	0-15	3-10	1.50-1.65	6.0-20	0.01-0.06	6.6-7.8	<2	Very low	0.15	5	1	<.5
	15-80	3-12	1.50-1.65	6.0-20	0.01-0.08	6.6-7.8	<2	Very low	0.15			
PYB: Pyote	0-24	3-12	1.40-1.60	6.0-20	0.03-0.09	6.6-7.8	<2	Low	0.17	5	2	<.5
	24-60	8-18	1.35-1.55	2.0-6.0	0.08-0.14	6.6-8.4	<2	Low	0.17			
	60-80	3-18	1.35-1.60	6.0-20	0.09-0.13	6.6-8.4	<2	Low	0.17			
RaA, RaB: Reagan	0-8	18-27	1.35-1.50	0.6-2.0	0.15-0.20	7.9-8.4	<2	Moderate	0.37	5	7	.5-2
	8-30	20-45	1.35-1.50	0.6-2.0	0.10-0.16	7.9-8.4	0-4	Moderate	0.32			
	30-80	25-45	1.45-1.65	0.6-2.0	0.10-0.16	7.9-8.4	0-4	Moderate	0.32			
REB: Reeves	0-16	18-27	1.35-1.45	0.6-2.0	0.14-0.16	7.9-9.0	2-8	Low	0.37	5	4L	.4-.6
	16-22	18-30	1.40-1.50	0.6-2.0	0.09-0.17	7.9-9.0	2-8	Moderate	0.37			
	22-80	---	---	---	---	---	---	----------	----			
Ro: Rioconcho	0-30	35-45	1.30-1.50	0.06-0.2	0.15-0.20	7.4-8.4	<2	High	0.32	5	4	1-2
	30-80	35-55	1.30-1.50	0.06-0.2	0.15-0.20	7.4-8.4	<2	High	0.32			
SAC: Sanderson	0-12	18-35	1.35-1.55	0.6-2.0	0.05-0.14	7.9-8.4	<4	Low	0.10	5	8	1-3
	12-80	18-35	1.35-1.55	0.6-2.0	0.05-0.14	7.9-8.4	<4	Low	0.10			
TEC*:												
Tencee	0-11	18-27	1.40-1.50	0.6-2.0	0.08-0.10	7.9-8.4	<2	Low	0.15	1	6	.3-.6
	11-24	---	---	---	---	---	---	----------	----			
	24-80	---	---	---	---	---	---	----------	----			
Upton	0-4	15-30	1.30-1.50	0.6-2.0	0.08-0.14	7.9-8.4	<2	Low	0.15	2	8	<1
	4-14	15-30	1.30-1.50	0.6-2.0	0.08-0.14	7.9-8.4	<2	Low	0.15			
	14-30	---	---	0.01-0.6	---	---	---	----------	----			
	30-80	15-30	1.35-1.55	0.6-2.0	0.01-0.06	7.9-8.4	<2	Low	0.15			
TOA: Tobosa	0-16	40-60	1.35-1.40	<0.06	0.12-0.18	7.4-8.4	<2	Very high	0.32	5	4	1-3
	16-40	40-60	1.35-1.40	<0.06	0.12-0.18	7.9-8.4	<2	Very high	0.32			
	40-80	40-60	1.35-1.40	<0.06	0.10-0.16	7.9-8.4	<2	High	0.32			
WKB: Wickett	0-16	5-12	1.40-1.60	6.0-20	0.06-0.10	6.6-7.8	<2	Low	0.17	2	2	0-1
	16-33	8-18	1.35-1.65	2.0-6.0	0.10-0.15	7.4-8.4	<2	Low	0.20			
	33-49	---	---	0.01-0.6	---	---	---	----------	----			
	49-80	5-18	1.40-1.80	2.0-6.0	0.07-0.15	7.9-8.4	<2	Low	0.20			

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 13.--Soil and Water Features

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Depth	Thick-ness	Uncoated steel	Concrete
					Ft			In		In			
AnA, AnB---------- Angelo	C	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
BKB--------------- Blakeney	C	None--------	---	---	>6.0	---	---	>60	---	7-20	Thin	Moderate	Low.
CrB*:													
Conger-----------	D	None--------	---	---	>6.0	---	---	>60	---	8-20	Thin	Moderate	Low.
Reagan-----------	B	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
ECC--------------- Ector	D	None--------	---	---	>6.0	---	---	4-20	Hard	---	---	High-----	Low.
ECE--------------- Ector	D	None--------	---	---	>6.0	---	---	4-20	Hard	---	---	High-----	Low.
EKA--------------- Ekal	D	None--------	---	---	+1-1.5	Perched	May-Sep	>60	---	---	---	High-----	High.
HMC--------------- Hollomex	B	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	High.
Ir---------------- Iraan	B	Occasional--	Very brief	May-Oct	>6.0	---	---	>60	---	---	---	High-----	Low.
KNB--------------- Kinco	A	None--------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
LZD, LZG---------- Lozier	D	None--------	---	---	>6.0	---	---	4-16	Hard	---	---	High-----	Low.
MeA, MeB---------- Mereta	C	None--------	---	---	>6.0	---	---	>60	---	14-20	Thin	High-----	Low.
NKC--------------- Noelke	D	None--------	---	---	>6.0	---	---	7-20	Hard	6-20	Thin	Moderate	Low.
OW*--------------- Oil-waste land	D	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Moderate.
PWC--------------- Penwell	A	None--------	---	---	>6.0	---	---	>60	---	---	---	Low------	Low.
PYB--------------- Pyote	A	None--------	---	---	>6.0	---	---	>60	---	--	---	High-----	Low.
RaA, RaB---------- Reagan	B	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
REB--------------- Reeves	B	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	High.

See footnote at end of table.

Table 13.--Soil and Water Features--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Depth	Thick-ness	Uncoated steel	Concrete
					Ft			In		In			
Ro---------------- Rioconcho	C	Occasional--	Very brief or brief.	Apr-Jun	>6.0	---	---	>60	---	---	---	High-----	Low.
SAC--------------- Sanderson	B	None--------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
TEC*:													
Tencee-----------	D	None--------	---	---	>6.0	---	---	>60	---	7-20	Thick	High-----	Low.
Upton------------	C	None--------	---	---	>6.0	---	---	>60	---	7-20	Thin	High-----	Low.
TOA--------------- Tobosa	B	None--------	---	---	+.5-0.5	Perched	Jul-Oct	>60	---	---	---	High-----	Low.
WKB--------------- Wickett	C	None--------	---	---	>6.0	---	---	>60	---	20-40	Thin	Low------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 14.--Physical Analyses of Selected Soils

(The analyses were performed by the National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska. Dashes indicate data were not available)

Soil name and sample number	Depth	Horizon	Particle-size distribution: Sand: Very coarse (2-1 mm)	Coarse (1-0.5 mm)	Medium (0.5-0.25 mm)	Fine (0.25-0.1 mm)	Very fine (0.1-0.05 mm)	Total (2.0-0.05 mm)	Silt (0.05-0.002 mm)	Clay (0.002 mm)	Bulk density (air dry)	Water content: H_2O at saturation	1/3 bar	15 bar
	In		Pct								g/cc	Pct(wt)	Pct(wt)	Pct(wt)
Reagan loam***	0-1/4	A1	0.1	2.6	3.7	11.2	27.2	44.8*	40.8	14.4	---	30.4	---	7.8
(S61TX-231-1)	1/4-3	A1	0.2	2.2	3.6	11.8	26.0	43.8*	37.7	18.5	---	28.4	17.3	9.2
	3-8	A2	0.2	2.2	3.1	10.0	23.3	38.8*	35.3	25.9	1.48	37.8	19.0	11.1
	8-17	Bw	0.2	2.3	2.8	8.7	20.6	34.6*	35.7	29.7	---	39.6	20.5	11.8
	17-30	Bk1	0.3	1.7	2.5	8.4	20.7	33.6*	35.9	30.5	1.40	39.0	20.0	11.6
	30-37	Bk2	0.1	1.5	2.1	6.9	16.6	27.2**	36.1	36.7	---	36.1	21.8	9.3
	37-50	Bk2	0.6	1.7	1.8	6.2	15.5	25.8**	34.7	39.5	1.64	34.6	20.7	9.0
	50-75	Bk3	0.5	2.0	2.2	7.8	18.4	30.9**	33.2	35.9	---	37.1	18.3	9.5
	75-91	Bk3	0.4	1.5	1.8	7.2	17.3	28.2**	33.4	38.4	---	51.2	---	10.8
Reagan loam****	0-2	A1	0.6	2.0	1.9	12.1	23.7	40.3	40.4	19.3	---	29.1	---	9.3
(S61TX-231-2)	2-8	A2	0.3	1.6	1.3	9.4	19.4	32.0	37.8	30.2	---	38.3	---	11.7
	8-15	Bw1	0.7	1.5	1.4	8.7	18.3	30.6	36.6	32.8	---	40.6	---	12.6
	15-23	Bw2	0.8	1.7	1.3	7.9	17.0	28.7	36.5	34.8	---	40.4	---	12.2
	23-29	Bw3	1.3	1.2	1.0	6.8	14.9	25.2	34.7	40.1	---	38.5	---	10.9
	29-38	Bk1	1.2	1.4	1.0	5.6	13.8	23.0	37.9	39.1	---	36.4	---	9.1
	38-50	Bk2	1.6	1.5	1.0	6.3	15.2	25.6	37.3	37.1	---	37.7	---	9.7
	50-62	Bk3	1.6	1.8	1.2	6.4	14.7	25.7	36.9	37.4	---	39.6	---	9.9
	62-77	BCk	0.8	1.5	1.1	5.2	10.9	19.5	44.7	35.8	---	48.0	---	11.0

* Carbonate grains: >50 percent (2-1 mm); 5 percent (1-0.05 mm).

** Carbonate grains: >50 percent (2-0.5 mm); 5-25 percent (0.5-0.05 mm).

*** This pedon is in the same location as the typical pedon for the Reagan series in the section “Soil Series and Their Morphology.”

**** This pedon is 15 miles north of Rankin on Texas Highway 349 to a pipeline and a power line, 3 miles west-southwest on an unpaved road, 5 miles northwest, and 570 feet southwest, on rangeland.

Table 15.--Chemical Analyses of Selected Soils

(The analyses were performed by the National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska. Dashes indicate data were not available)

Soil name and sample number	Depth	Horizon	Extractable bases: Ca	Mg	Na	K	Sum	CEC (NaOAc)	CEC (NH_4OAc)	Organic carbon	pH (1:1 H_2O)	$CaCO_3$ (<2 mm)	Exchangeable sodium	Electrical conductivity
	In		-----Milliequivalents/100 grams of soil------							Pct		Pct	Pct	Mhos/cm
Reagan loam*	0-1/4	A1	14.2	1.7	TR	1.1	17.0	15.0	14.8	0.96	7.9	5	<1	1.10
(S61TX-231-1)	1/4-3	A1	16.9	1.7	TR	1.3	19.9	18.1	17.2	0.90	8.0	7	<1	0.57
	3-8	A2	17.8	1.2	0.1	0.7	19.8	18.9	17.7	0.97	7.9	12	<1	0.48
	8-17	Bw	17.9	1.5	0.1	0.5	20.0	18.6	17.1	0.72	7.8	16	<1	0.73
	17-30	Bk1	17.8	1.9	0.4	0.5	20.6	18.4	17.1	0.60	7.6	18	1	2.50
	30-37	Bk2	11.8	1.7	0.9	0.3	14.7	12.0	10.4	0.33	7.8	42	4	2.95
	37-50	Bk2	10.3	2.1	1.4	0.3	14.1	10.4	9.5	0.18	7.9	45	8	3.54
	50-75	Bk3	11.0	2.2	2.2	0.4	15.8	11.2	10.5	0.13	7.9	37	12	4.64
	75-91	Bk3	11.7	2.9	2.8	0.4	17.8	12.0	11.4	0.10	7.9	38	13	4.36
Reagan loam**	0-2	A1	15.8	1.4	TR	1.7	18.9	16.8	16.0	1.14	8.1	13	<1	0.62
(S61TX-231-2)	2-8	A2	17.8	1.5	TR	1.2	20.5	18.6	17.2	1.08	8.0	18	<1	0.54
	8-15	Bw1	17.3	1.4	0.1	0.6	19.4	19.6	16.3	0.88	7.9	22	<1	0.66
	15-23	Bw2	16.9	1.2	0.2	0.5	18.8	17.3	15.1	0.67	7.6	28	1	1.59
	23-29	Bw3	14.1	1.6	0.2	0.4	16.3	14.6	12.8	0.51	7.7	39	1	1.59
	29-38	Bk1	10.7	1.8	0.4	0.3	13.2	10.6	9.1	0.25	7.8	51	2	2.49
	38-50	Bk2	11.2	2.5	0.7	0.3	14.7	11.5	9.7	0.14	7.8	43	3	3.47
	50-62	Bk3	11.0	2.2	0.9	0.3	14.4	10.8	9.2	0.17	7.7	46	5	3.80
	62-77	BCk	--	2.0	1.0	0.4	--	11.1	10.3	0.10	7.6	33	7	4.68

* This pedon is in the same location as the typical pedon for the Reagan series in the section “Soil Series and Their Morphology.”

** This pedon is 15 miles north of Rankin on Texas Highway 349 to a pipeline and a power line, 3 miles west-southwest on an unpaved road, 5 miles northwest, and 570 feet southwest, on rangeland.

Table 16.--Engineering Index Test Data

(Dashes indicate that data were not available. LL means liquid limit and PI, plasticity index. The analyses were performed by the Texas Department of Highways and Public Transportation Soil Laboratory, Austin Texas)

Soil name, map symbol, report number, horizon, and depth in inches	Classification		Grain-size distribution											LL[2]	PI[2]	Shrinkage		
			Percentage[1] passing sieve--								Percentage smaller than--					Limit	Linear	Ratio
	AASHTO	Unified	3 in.	1 1/4 in.	5/8 in.	3/8 in.	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm					
														Pct		Pct	Pct	
Conger[3]																		
(S85TX-383-002)																		
A------------0-10	A-4 (3)	CL	---	100	97	95	92	91	89	53	36	17	14	28	10	17	5.8	1.81
C-----------33-80	A-2-4 (0)	SM	---	100	97	92	82	70	55	35	31	12	7	30	6	22	3.7	1.63
Hollomex[4]																		
(S85TX-383-030)																		
Bw-----------5-20	A-6 (16)	CL	---	---	---	---	100	99	99	91	81	42	25	37	18	17	9.8	1.79
C-----------20-60	A-7-6 (10)	ML	---	---	---	---	100	99	92	66	65	9	7	45	16	26	8.1	1.55
Kinco[5]																		
(S85TX-461-036)																		
Bw-----------6-28	A-4 (1)	SC	---	---	---	---	---	100	99	49	40	26	20	24	9	15	5.3	1.86
Bk----------28-60	A-6 (7)	CL	---	---	---	---	100	99	99	66	52	38	29	27	16	8	10.8	1.95
Lozier[6]																		
(S85TX-461-037)																		
A------------0-12	A-2-6 (0)	GM	100	80	64	55	44	36	29	24	18	6	3	38	11	20	8.2	1.67
Penwell[6]																		
(S85TX-461-045)																		
A------------0-20	A-2-4 (0)	SP	---	---	---	---	---	100	99	4	4	4	4	17	2	15	0	1.69
Reeves[7]																		
(S85TX-383-032)																		
Bw-----------6-22	A-6 (16)	CL	---	---	---	---	---	---	100	92	78	40	25	39	19	19	9.6	1.76
Bk----------22-63	A-7-5 (8)	ML	---	---	---	100	98	96	86	64	60	12	6	44	13	29	6.9	1.51
Sanderson[6]																		
(S85TX-461-092)																		
Bw----------12-63	A-2-4 (0)	SC	100	96	84	73	57	44	34	24	23	11	7	28	10	15	7.2	1.84
Tencee[6]																		
(S85TX-461-038)																		
A------------0-10	A-1-5 (0)	GC-GM	100	83	58	45	35	31	30	17	13	5	3	25	6	16	4.7	1.78
C-----------32-80	A-2-4 (0)	SM	---	100	81	71	59	44	32	16	15	5	3	35	9	25	4.7	1.58

See footnotes at end of table.

Table 16.--Engineering Index Test Data--Continued

Soil name, map symbol, report number, horizon, and depth in inches	Classification: AASHTO	Classification: Unified	Percentage[1] passing sieve--: 3 in.	1 1/4 in.	5/8 in.	3/8 in.	No. 4	No. 10	No. 40	No. 200	Percentage smaller than--: .05 mm	.005 mm	.002 mm	LL[2]	PI[2]	Shrinkage: Limit	Linear	Ratio
														Pct		Pct	Pct	
Upton[6]																		
(S85TX-461-049)																		
Bw-----------4-14	A-2-6 (1)	SC	100	84	68	61	53	48	44	34	27	13	8	33	14	19	6.9	1.72
C-----------30-80	A-2-7 (0)	GP-GM	---	100	89	71	43	26	17	9	9	4	3	50	14	35	6.2	1.35

[1] For soil materials larger than 3/8 inch, square mesh wire sieves that are slightly larger than equivalent round sieves were used, but this difference in procedure did not have a serious effect on the data.

[2] Liquid limit and plasticity index values were determined by the AASHTO-89 methods, except that soil was added to the water.

[3] This pedon is located in Reagan County, 13.7 miles north of Best on an unpaved road, 3 miles west on another unpaved road, 100 yards east.

[4] This pedon is located in Reagan County, from U.S. Highway 67 and Ranch Road 1555, 1.8 miles north on Ranch Road 1555, 50 yards west, on rangeland.

[5] This pedon is located in Upton County, from Crane County line, 5 miles east on Texas Highway 329, 0.9 mile south on a ranch road, 0.4 mile east on a ranch road.

[6] This pedon is in the same location as the typical pedon for the series in the section “Soil Series and Their Morphology.”

[7] This pedon is located in Reagan County, from the Glasscock County line, 4.1 miles south on Ranch Road 1357, 50 yards east, on rangeland.

Table 17.--Classification of the Soils

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Angelo	Fine-silty, mixed, superactive, thermic Aridic Calciustolls
Blakeney	Loamy, mixed, superactive, thermic, shallow Ustic Petrocalcids
Conger	Loamy, mixed, superactive, thermic, shallow Ustic Petrocalcids
Ector	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
Ekal	Fine, smectitic, calcareous, thermic Vertic Epiaquolls
*Hollomex	Fine-loamy, gypsic, thermic Typic Torriorthents
Iraan	Fine-silty, mixed, superactive, thermic Cumulic Haplustolls
Kinco	Coarse-loamy, mixed, superactive, thermic Ustic Haplocalcids
Lozier	Loamy-skeletal, carbonatic, thermic Lithic Haplocalcids
Mereta	Clayey, mixed, superactive, thermic, shallow Petrocalcic Calciustolls
Noelke	Loamy-skeletal, mixed, superactive, thermic Lithic Petrocalcic Calciustolls
Penwell	Siliceous, thermic Ustic Torripsamments
Pyote	Loamy, siliceous, active, thermic Arenic Ustic Haplargids
Reagan	Fine-silty, mixed, superactive, thermic Ustic Haplocalcids
Reeves	Fine-loamy, gypsic, thermic Ustic Calcigypsids
Rioconcho	Fine, mixed, superactive, thermic Vertic Haplustolls
Sanderson	Loamy-skeletal, carbonatic, thermic Ustic Haplocambids
Tencee	Loamy-skeletal, carbonatic, thermic, shallow Calcic Petrocalcids
Tobosa	Fine, smectitic, thermic Aridic Haplusterts
Upton	Loamy, carbonatic, thermic, shallow Calcic Petrocalcids
Wickett	Coarse-loamy, siliceous, superactive, thermic Ustalfic Petrocalcids

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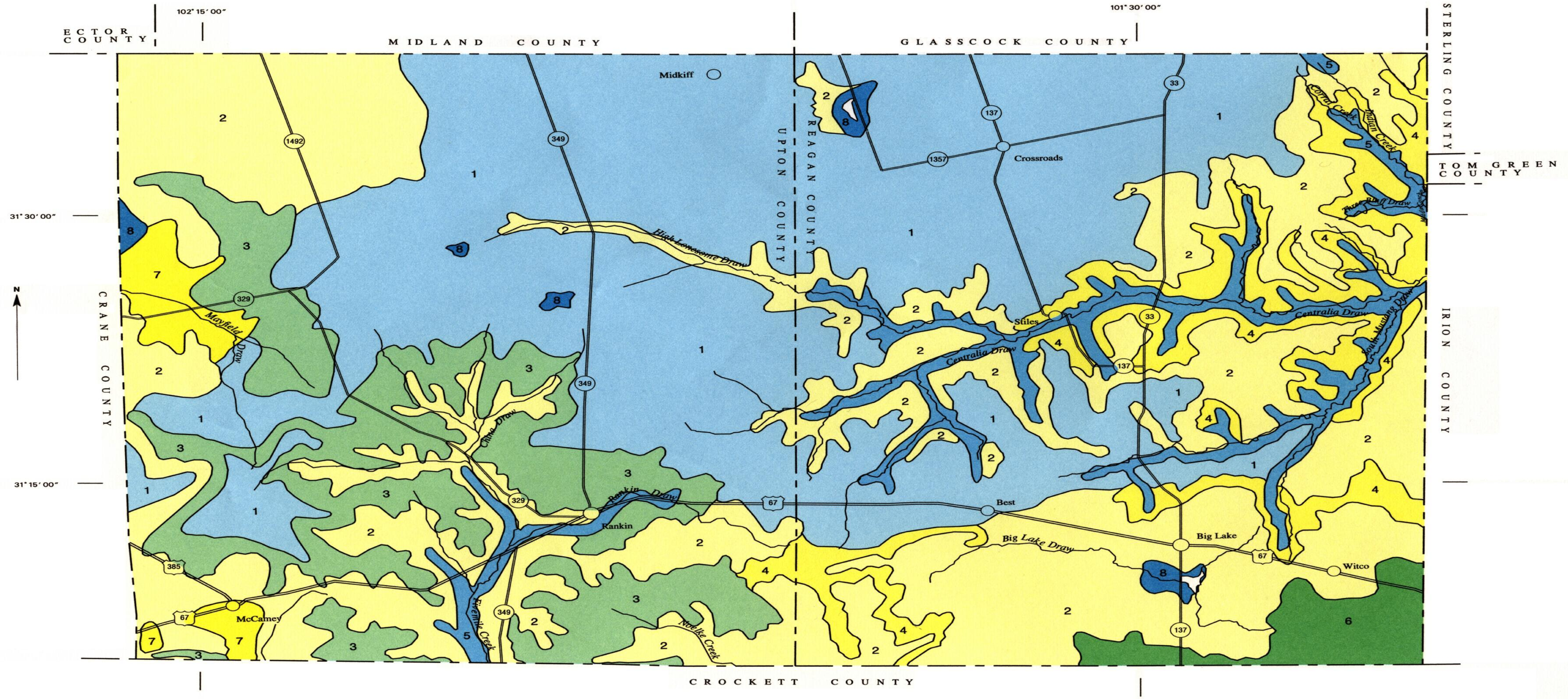


SOIL LEGEND*

1 Reagan
2 Reagan-Conger
3 Lozier-Tencee
4 Ector-Conger
5 Iraan-Rioconcho-Reagan
6 Angelo-Noelke-Mereta
7 Kinco-Wickett-Pyote
8 Reeves-Hollomex-Ekal

*The units on this legend are described in the text under the heading "General Soil Map Units."

Compiled 1990

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
Reagan and Upton Counties, TEXAS

Scale 1:380160

1 0 1 2 3
MILES

1 0 1 2 3 4 5 6
KILOMETERS

Each area outlined on this map consists of more than one kind of soil. The map is meant for general planning rather than a basis for decisions on the use of specific tracts.

INDEX TO MAP SHEETS

Reagan and Upton Counties, TEXAS

Scale 1:380160

1 0 1 2 3
MILES

1 0 1 2 3 4 5 6
KILOMETERS

SOIL LEGEND

The first letter in the publication symbol, always a capital, is the initial letter of the soil name or miscellaneous area. The second letter is a capital if the map unit is broadly defined*; otherwise, it is a lowercase letter. The third letter, if used, is always a capital letter and denotes the slope. Symbols without slope letters are those of nearly level soils or miscellaneous areas.

SYMBOL	NAME
AnA	Angelo silty clay loam, 0 to 1 percent slopes
AnB	Angelo silty clay loam, 1 to 3 percent slopes
BKB	Blakeney fine sandy loam, 1 to 3 percent slopes
CrB	Conger-Reagan association, 0 to 3 percent slopes
ECC	Ector very gravelly loam, 3 to 8 percent slopes
ECE	Ector very gravelly loam, 8 to 30 percent slopes, very stony
EKA	Ekal clay, 0 to 1 percent slopes, depressional
HMC	Hollomex loam, 1 to 8 percent slopes
Ir	Iraan silty clay loam, occasionally flooded
KNB	Kinco fine sandy loam, 0 to 2 percent slopes
LZD	Lozier very gravelly loam, 2 to 15 percent slopes
LZG	Lozier very gravelly loam, 15 to 55 percent slopes, very stony
MeA	Mereta clay loam, 0 to 1 percent slopes
MeB	Mereta clay loam, 1 to 3 percent slopes
NKC	Noelke very gravelly silty clay loam, 0 to 5 percent slopes
OW	Oil-waste land
PWC	Penwell fine sand, undulating
PYB	Pyote loamy fine sand, 0 to 3 percent slopes
RaA	Reagan loam, 0 to 1 percent slopes
RaB	Reagan loam, 1 to 3 percent slopes
REB	Reeves loam, 0 to 5 percent slopes
Ro	Rioconcho silty clay loam, occasionally flooded
SAC	Sanderson very gravelly loam, 1 to 8 percent slopes
TEC	Tencee and Upton soils, 1 to 8 percent slopes
TOA	Tobosa clay, 0 to 1 percent slopes, depressional
WKB	Wickett loamy fine sand, 0 to 3 percent slopes

*Fewer soil examinations were made in these map units, and delineations and included areas are generally larger. The map units were designed primarily for range management.

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- County or parish
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

LAND DIVISION CORNER (sections and land grants)

ROADS

- County, farm or ranch
- Trail

ROAD EMBLEM & DESIGNATIONS

- Federal
- State
- County, farm or ranch

FENCE (normally not shown)

PITS

- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban area) (occupied)
- Church
- School
- Windmill

WATER FEATURES

DRAINAGE

- Intermittent
- Drainage end

SPECIAL SYMBOLS FOR SOIL SURVEY

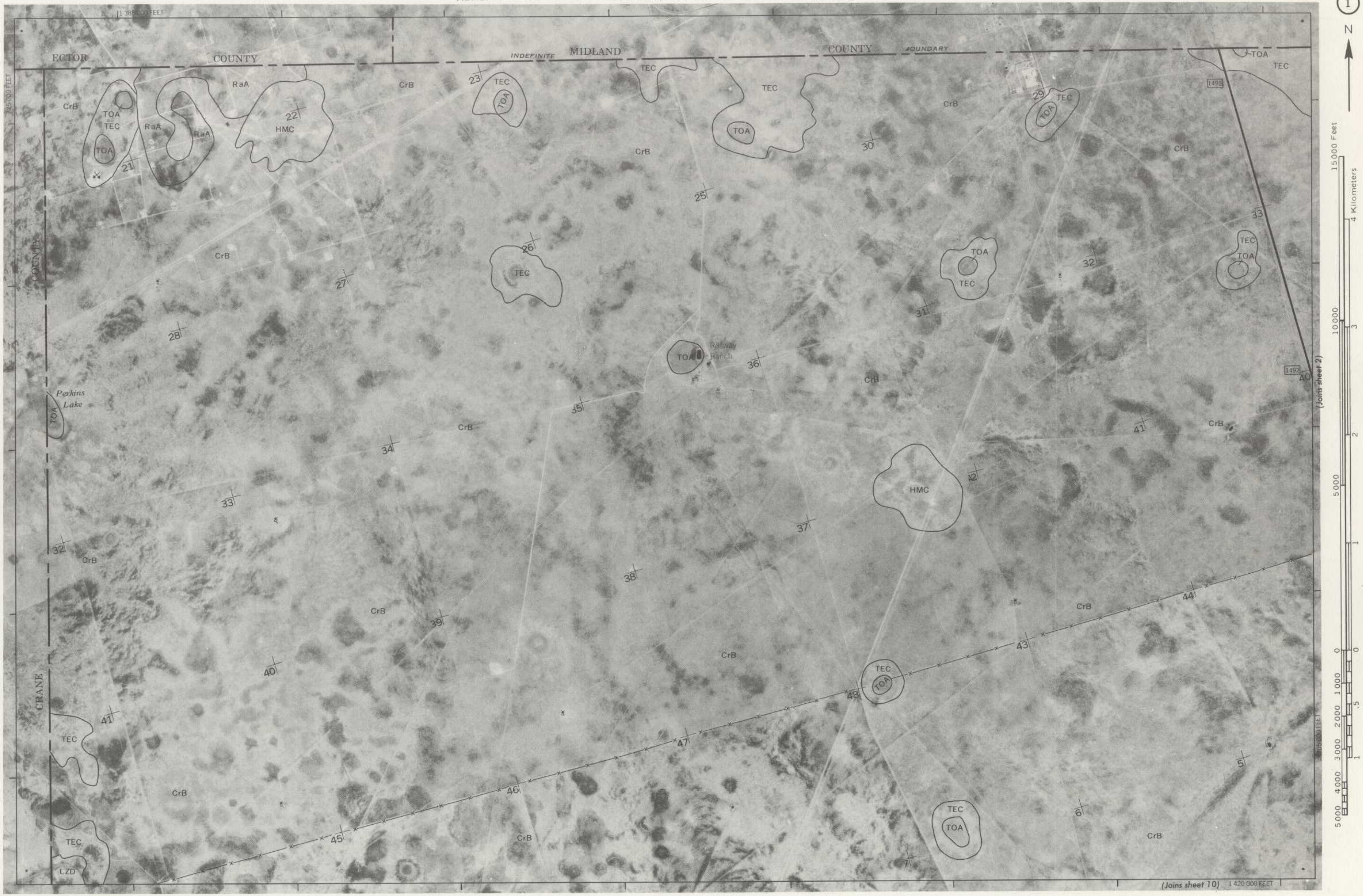
SOIL DELINEATIONS AND SYMBOLS

SOIL SAMPLE (normally not shown)

MISCELLANEOUS

- Butterfield trail

This soil survey map was compiled by the U. S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. Base maps are prepared from 1980 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



REAGAN AND UPTON COUNTIES, TEXAS — SHEET NUMBER 2

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REAGAN AND UPTON COUNTIES, TEXAS — SHEET NUMBER 4

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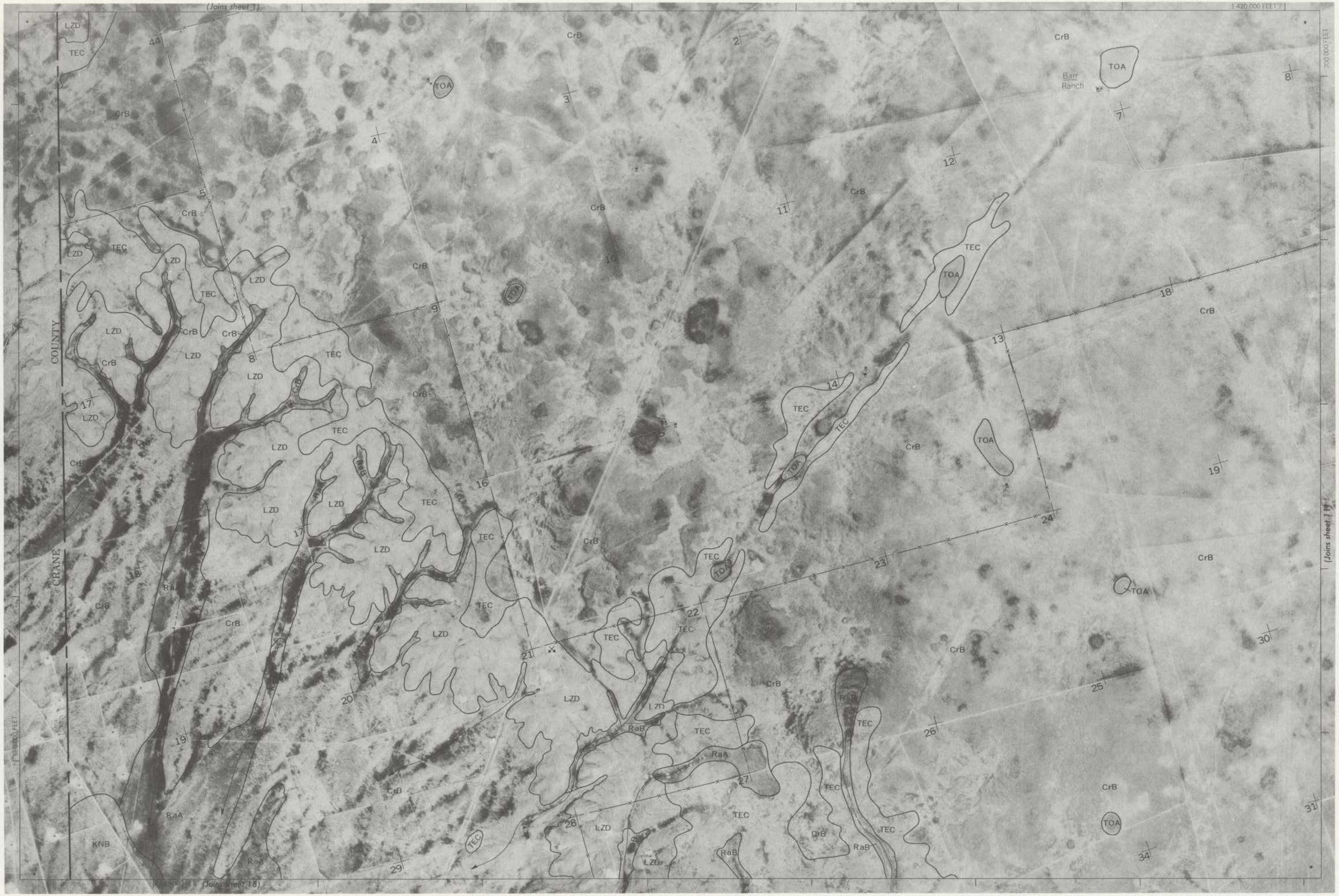

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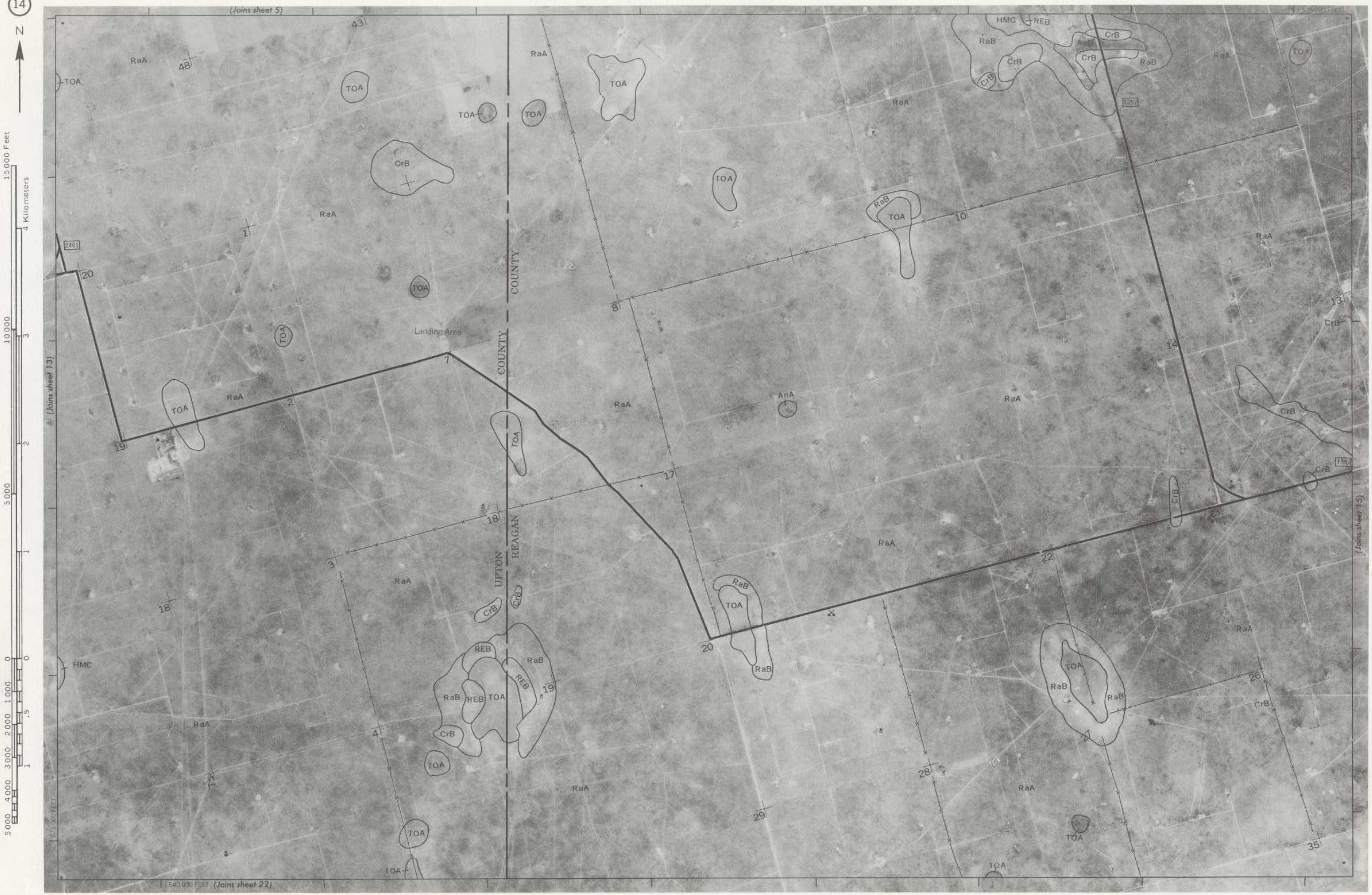

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15

N

15 000 Feet
10 000
5000
0
1000
2000
3000
4000
5000
4 Kilometers
3
2
1
0
.5
1

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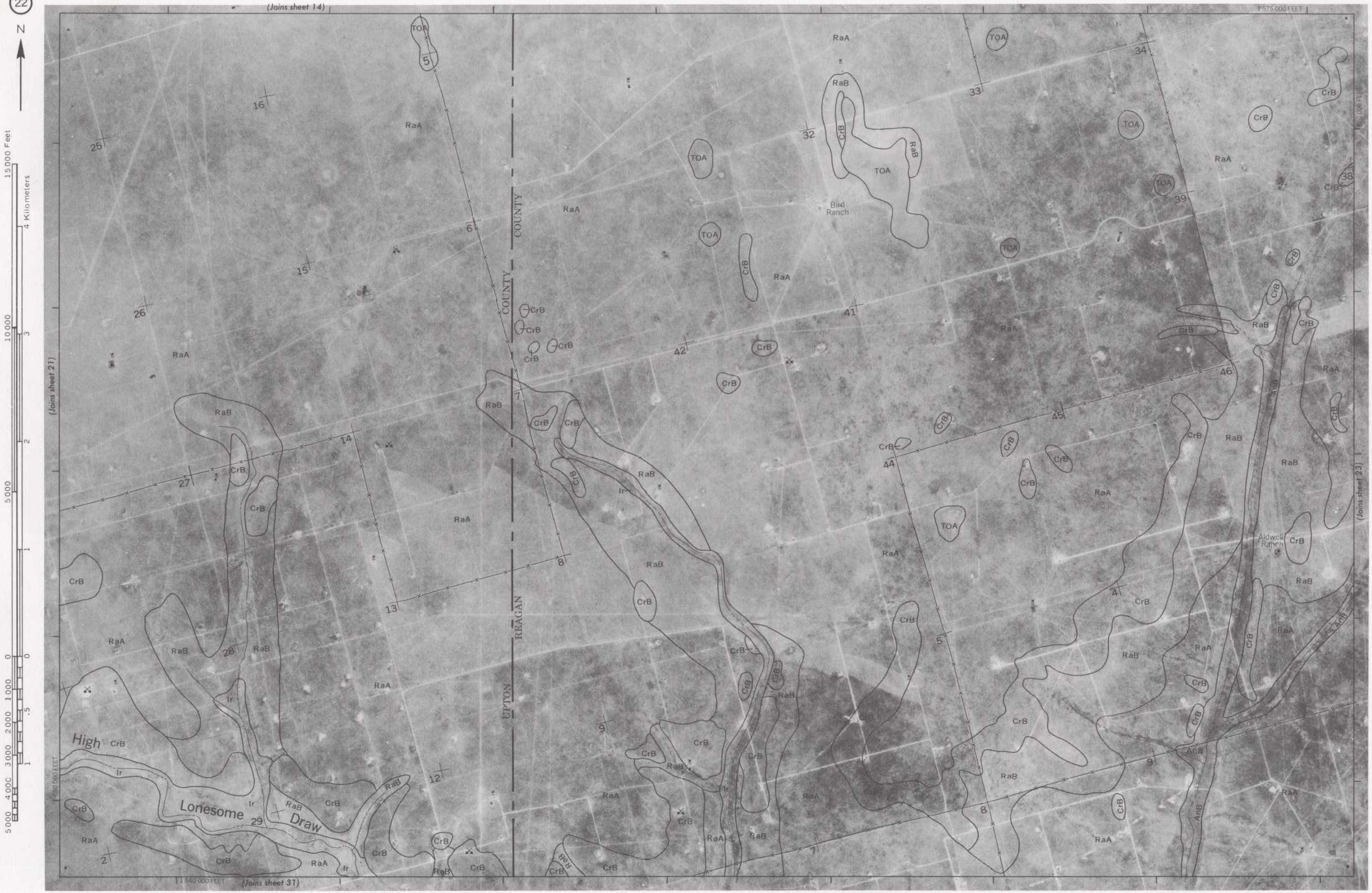

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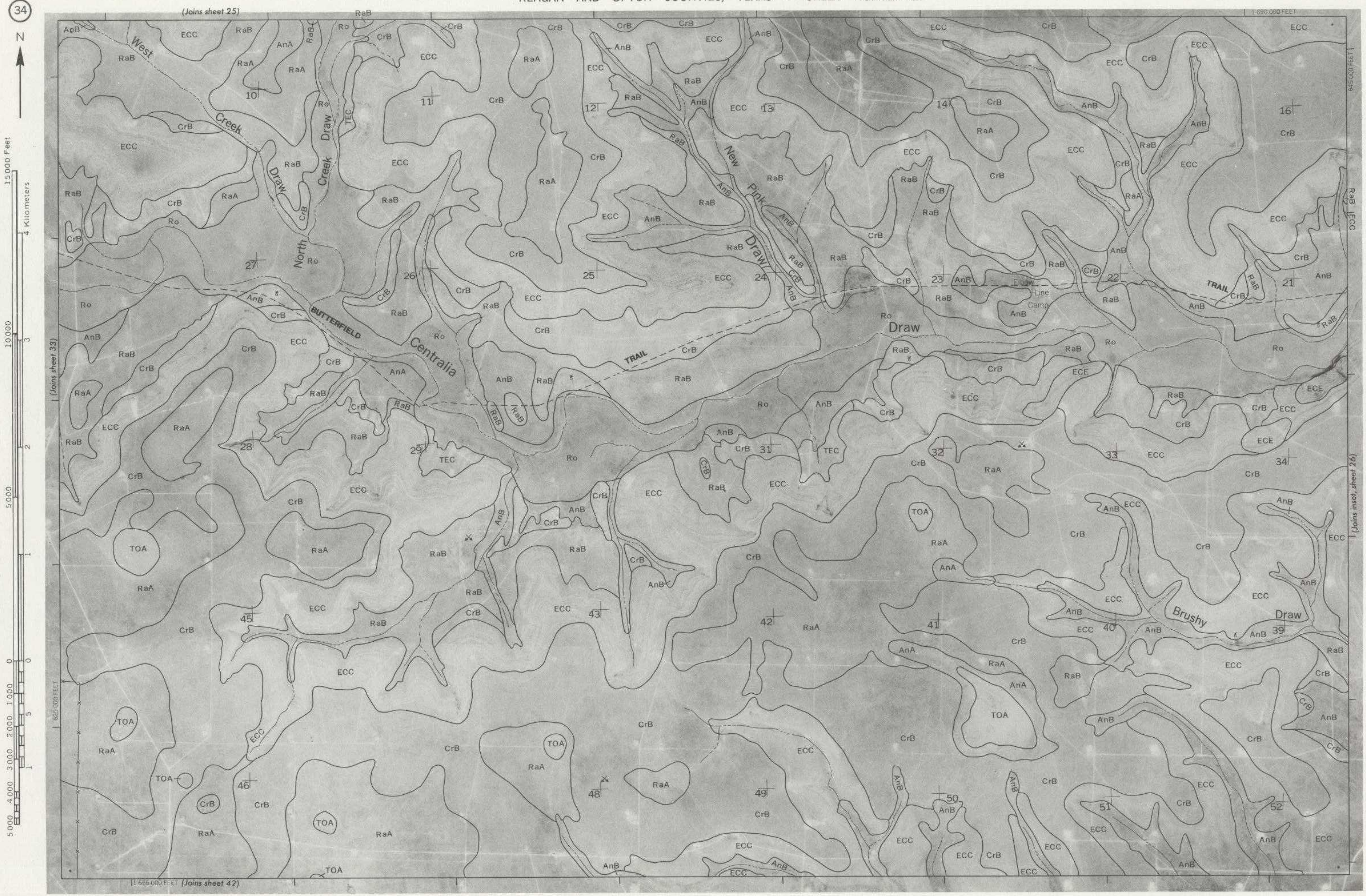

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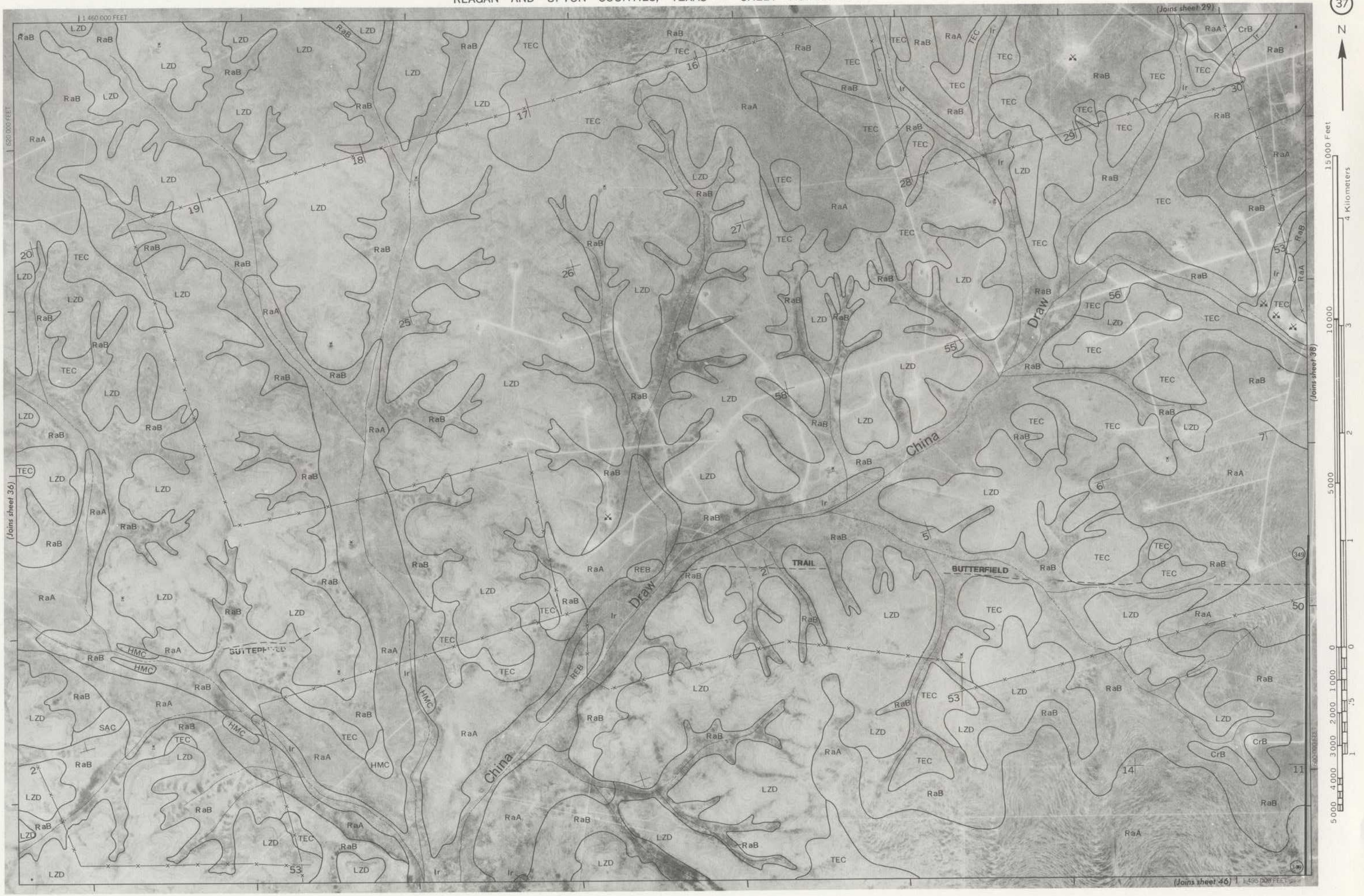

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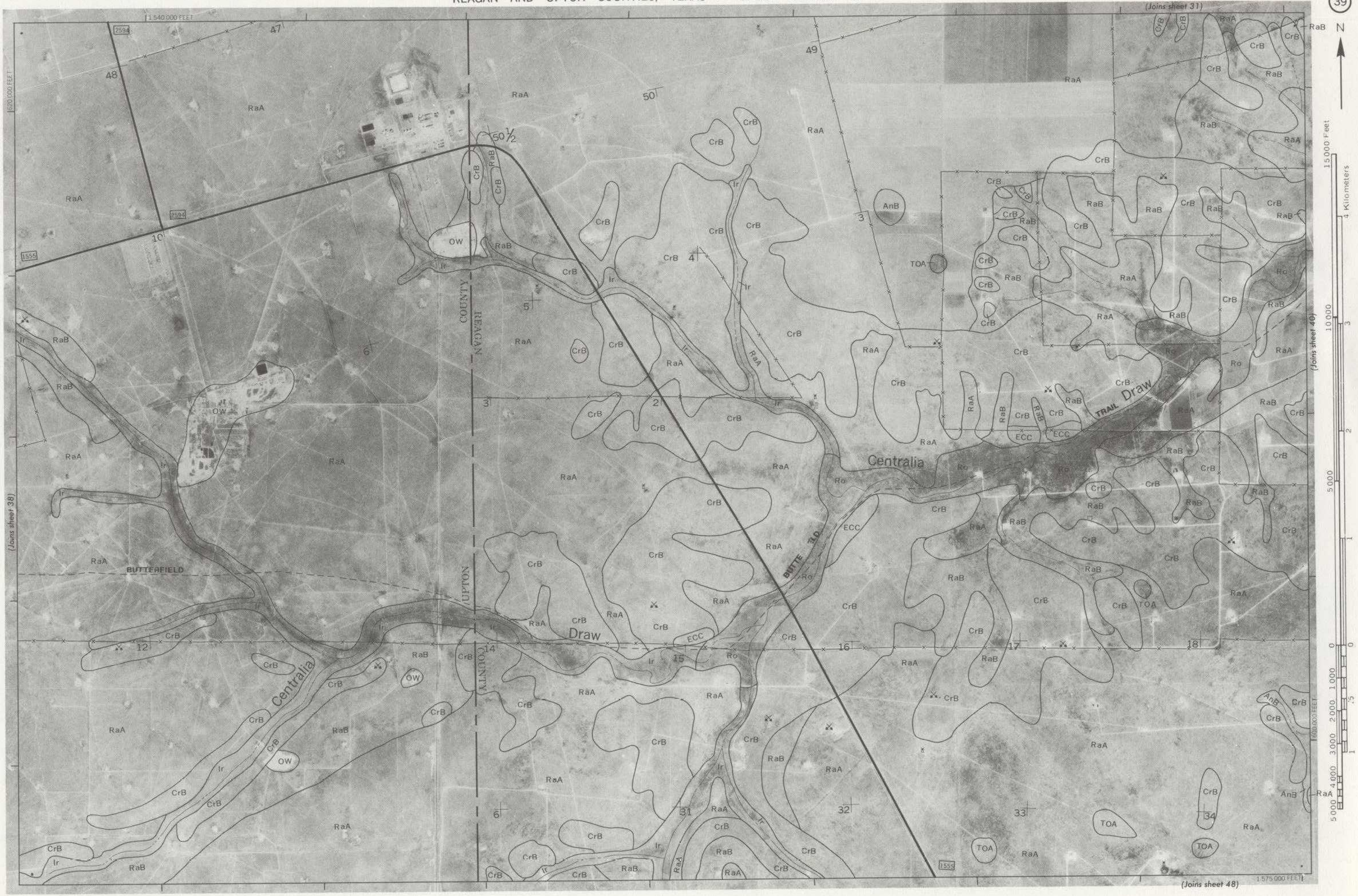

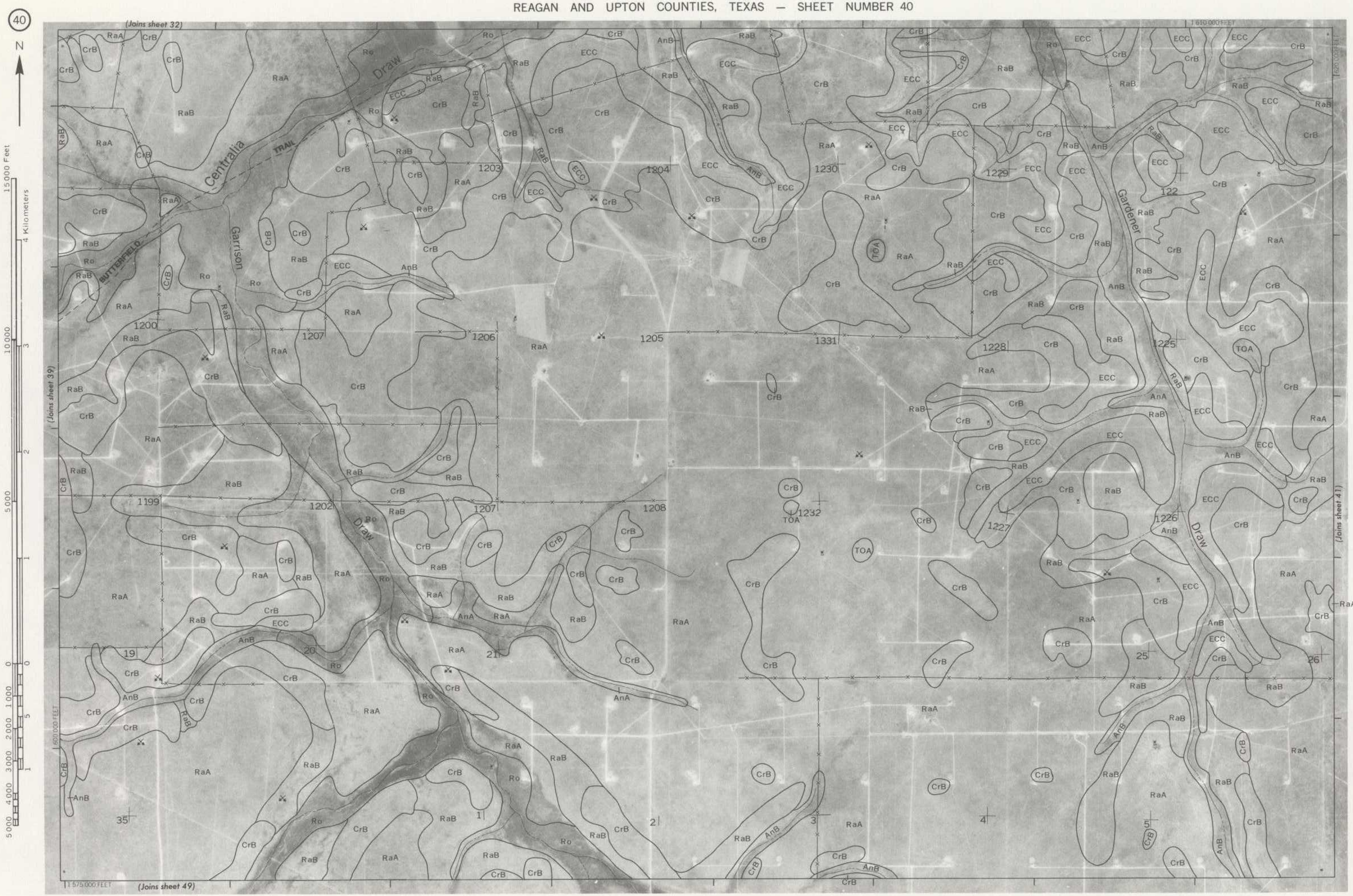

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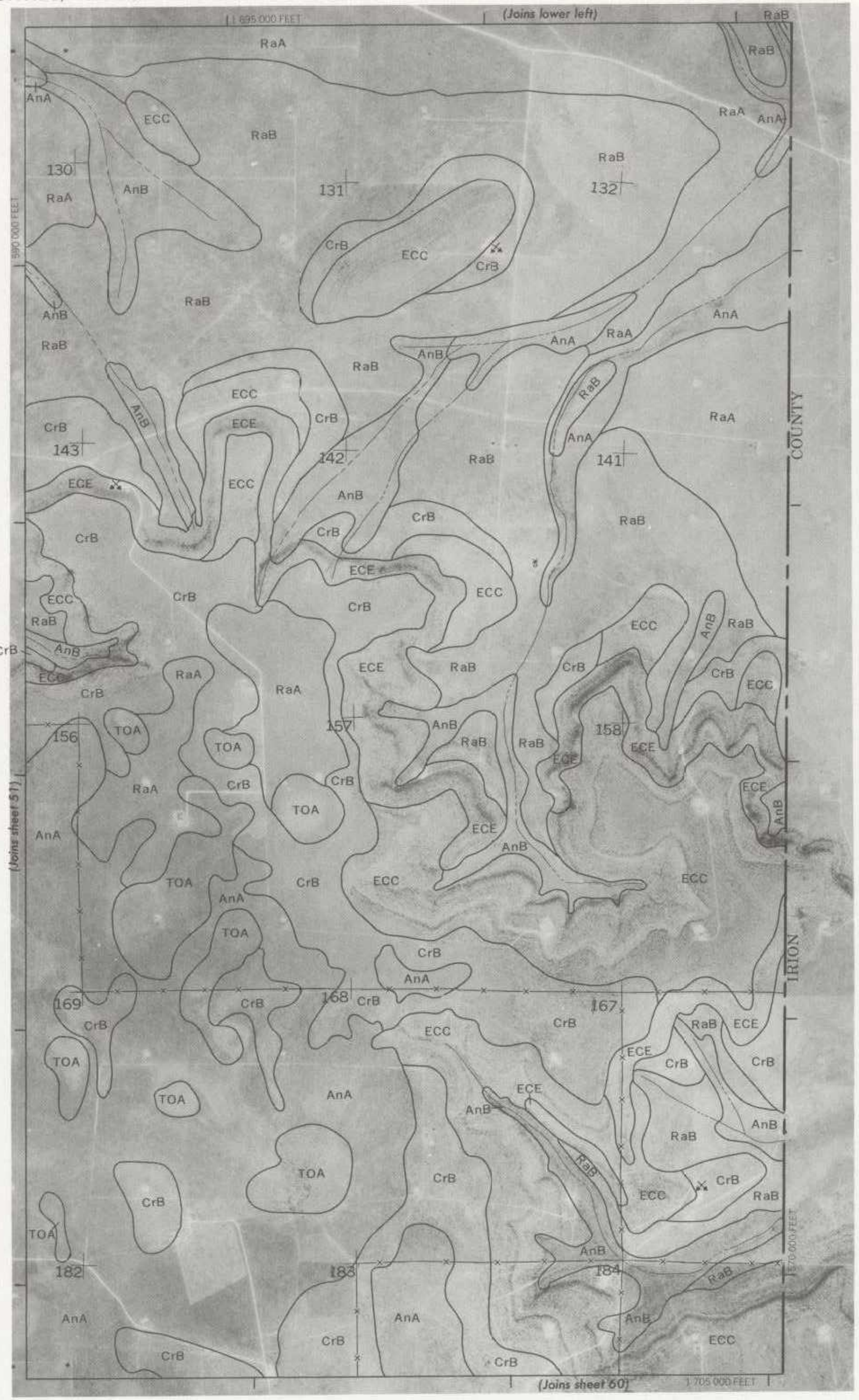

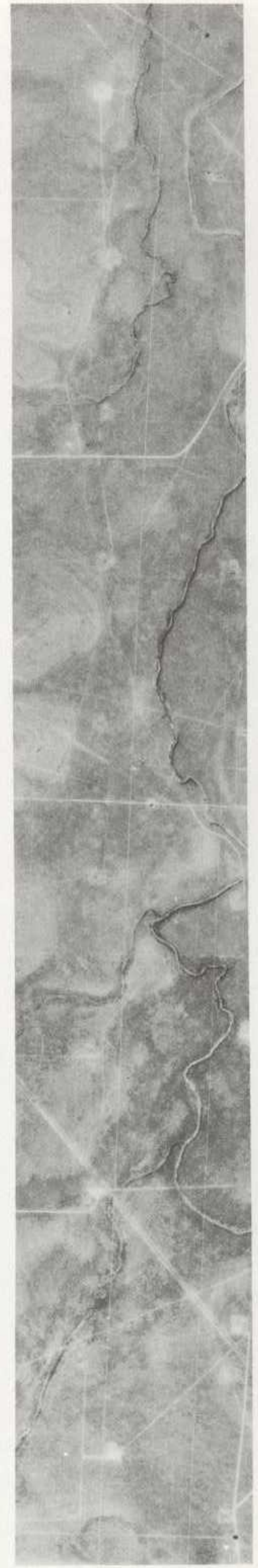

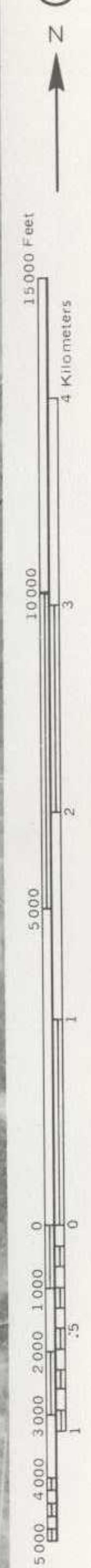

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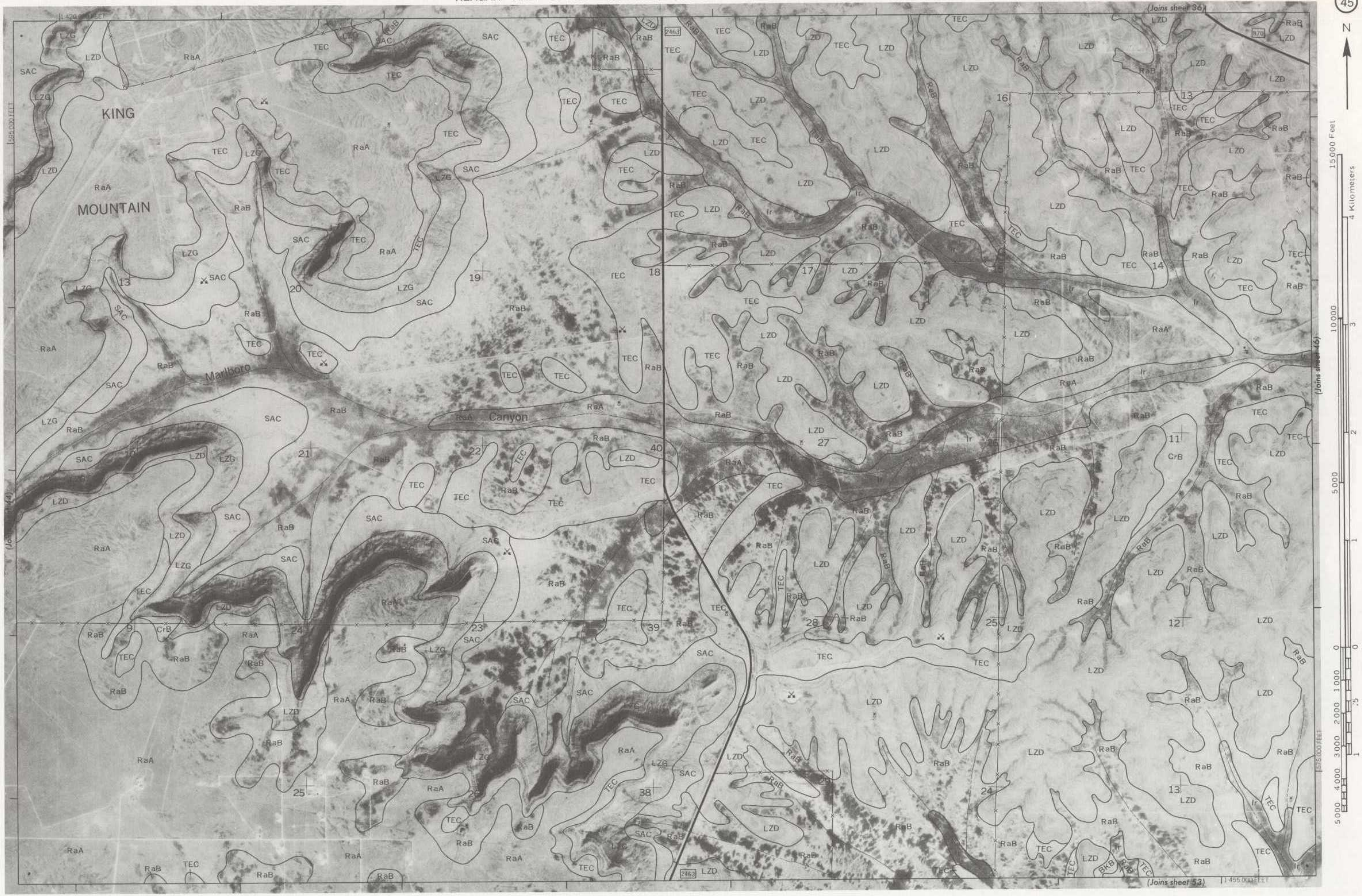

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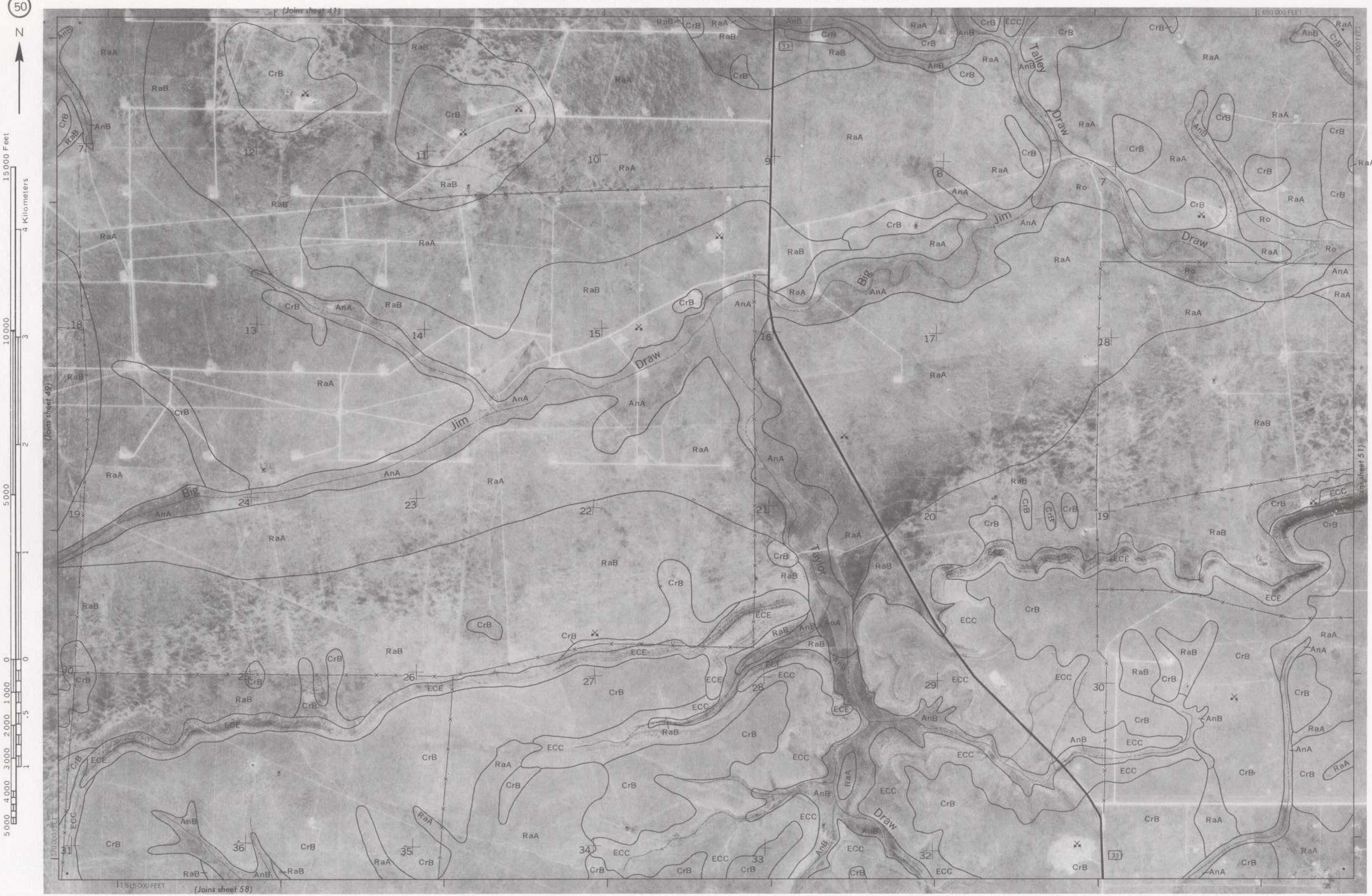

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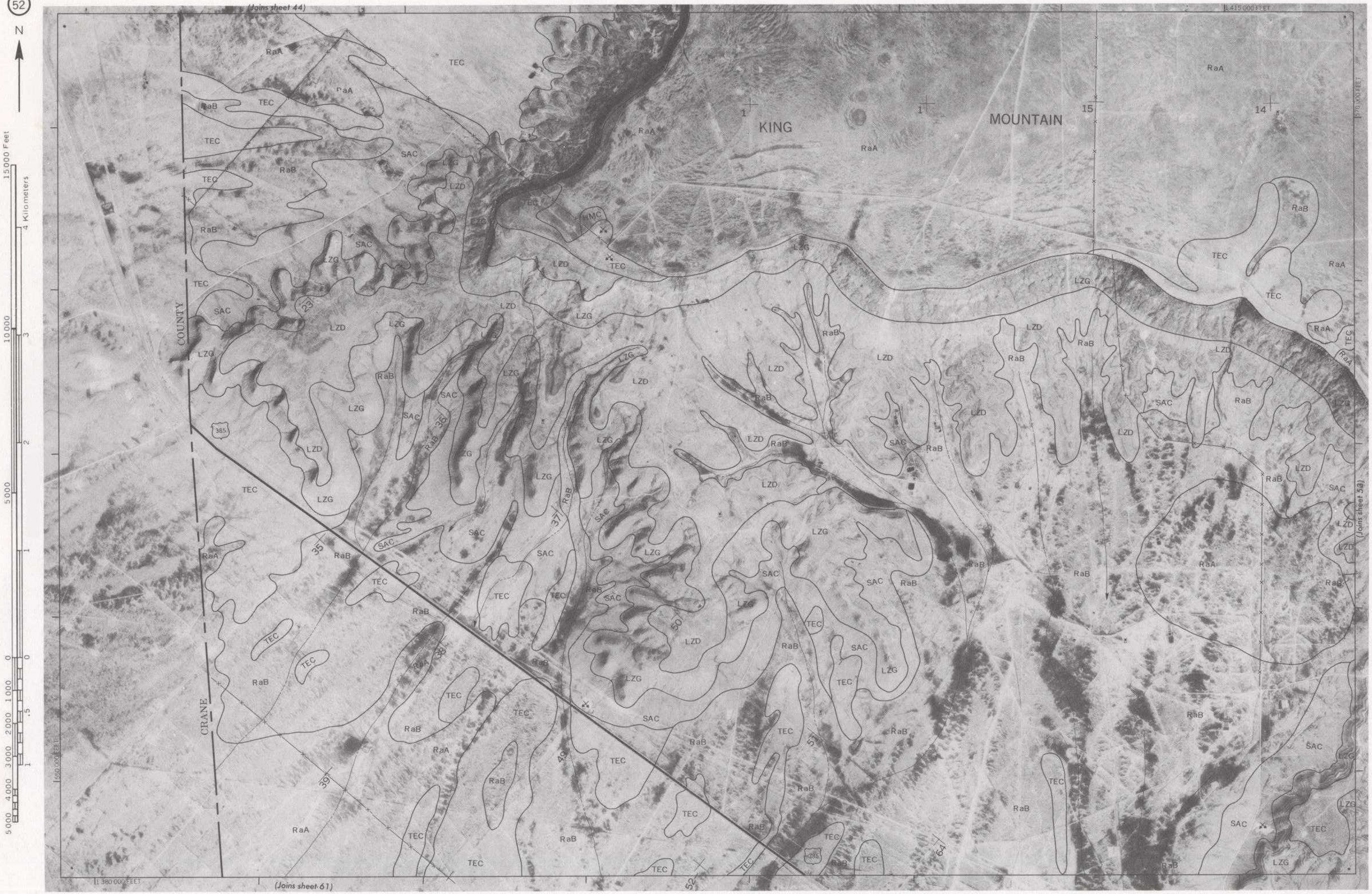

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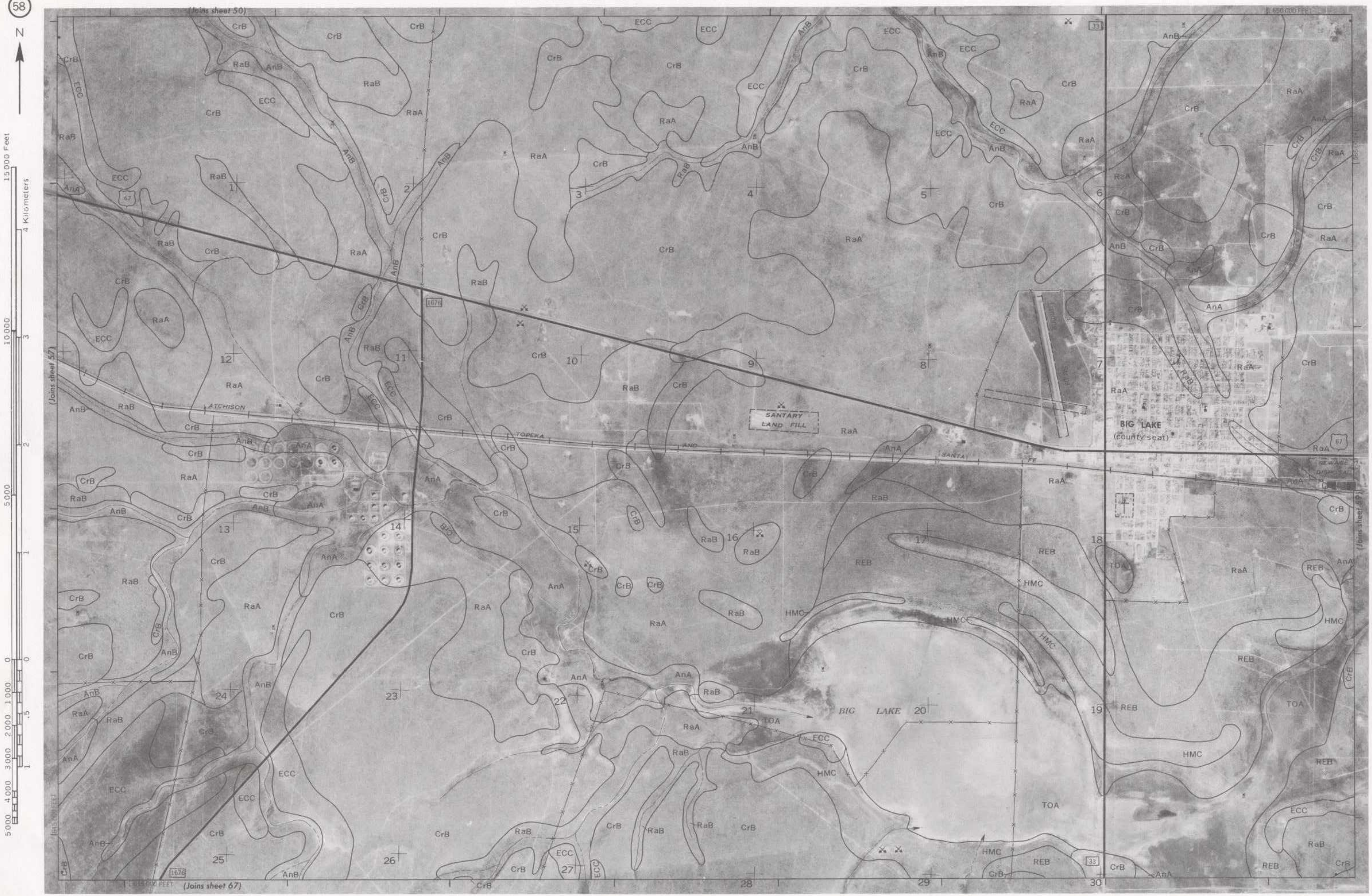

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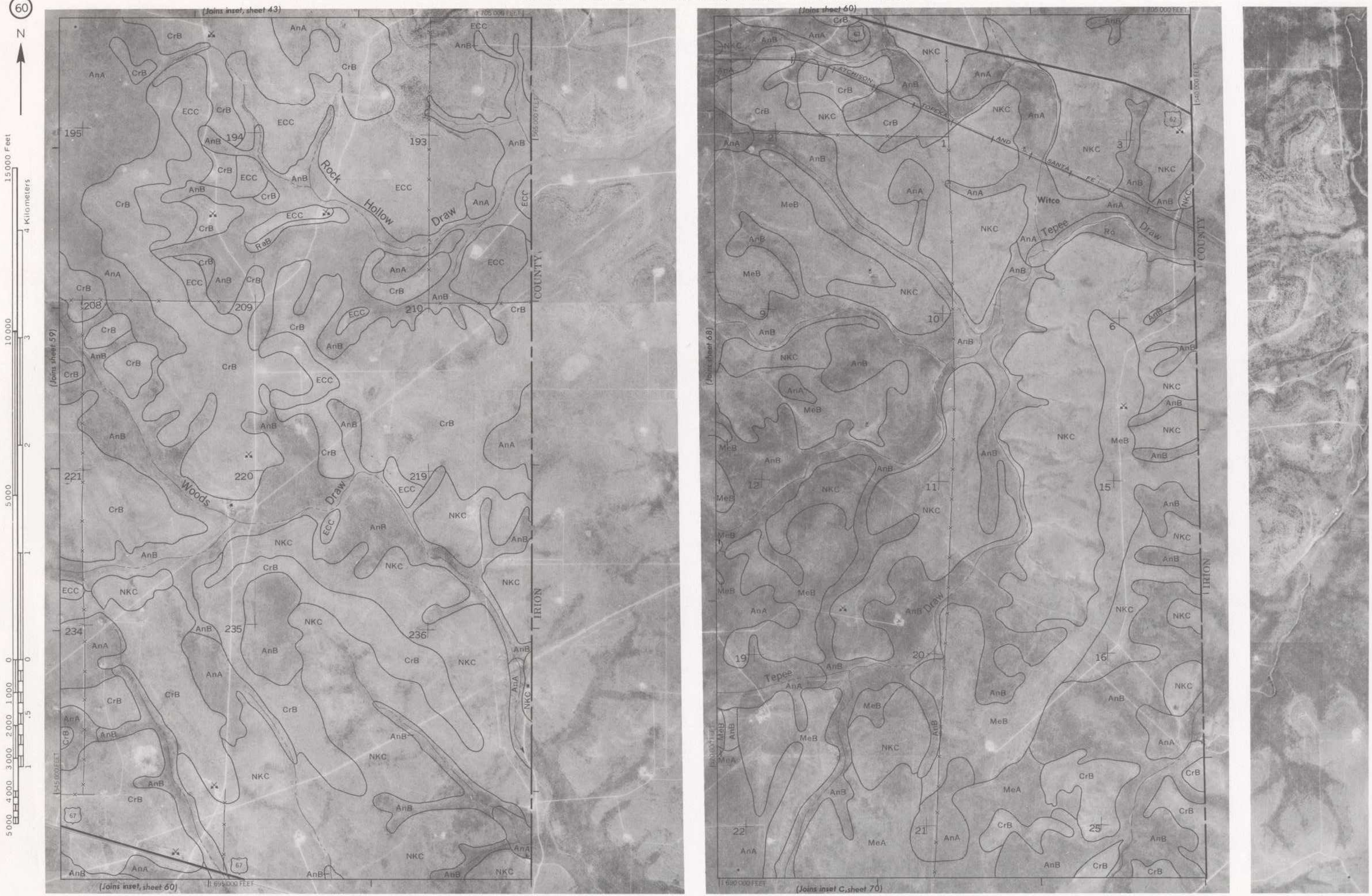

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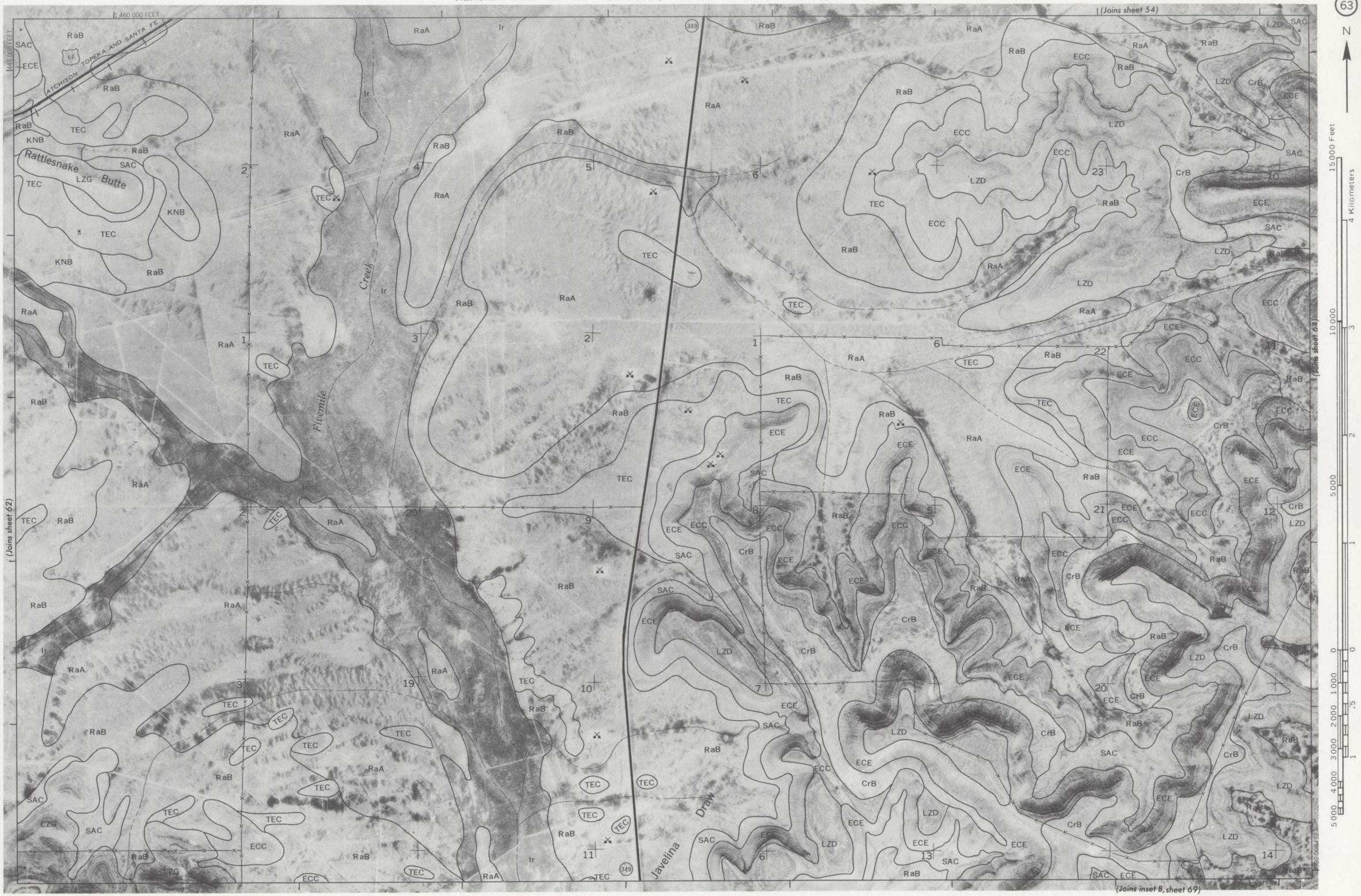

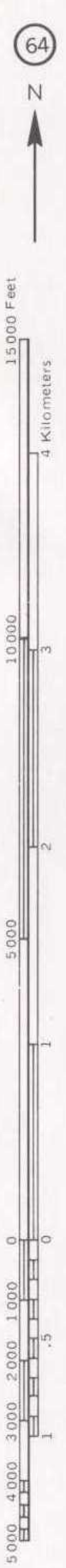

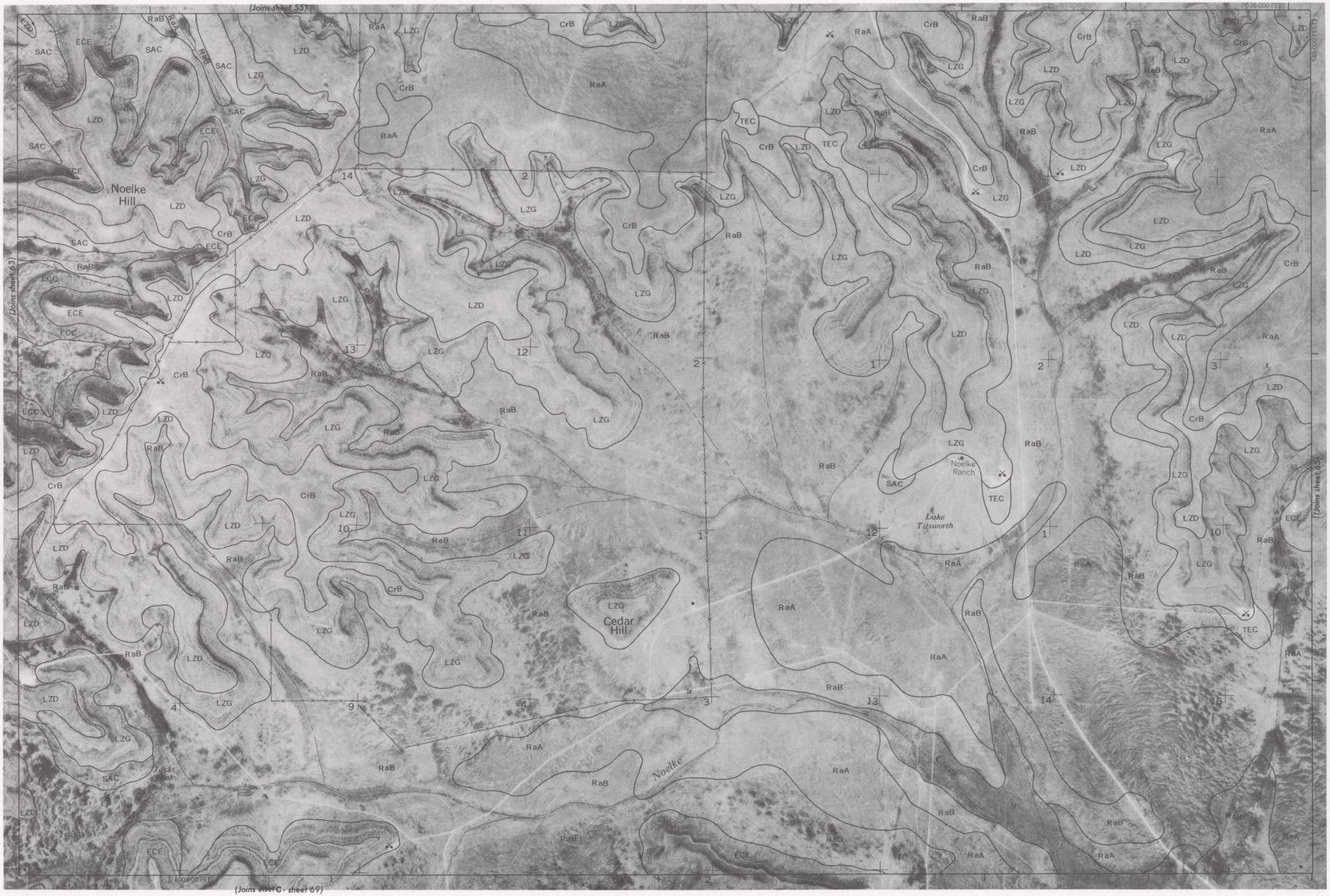

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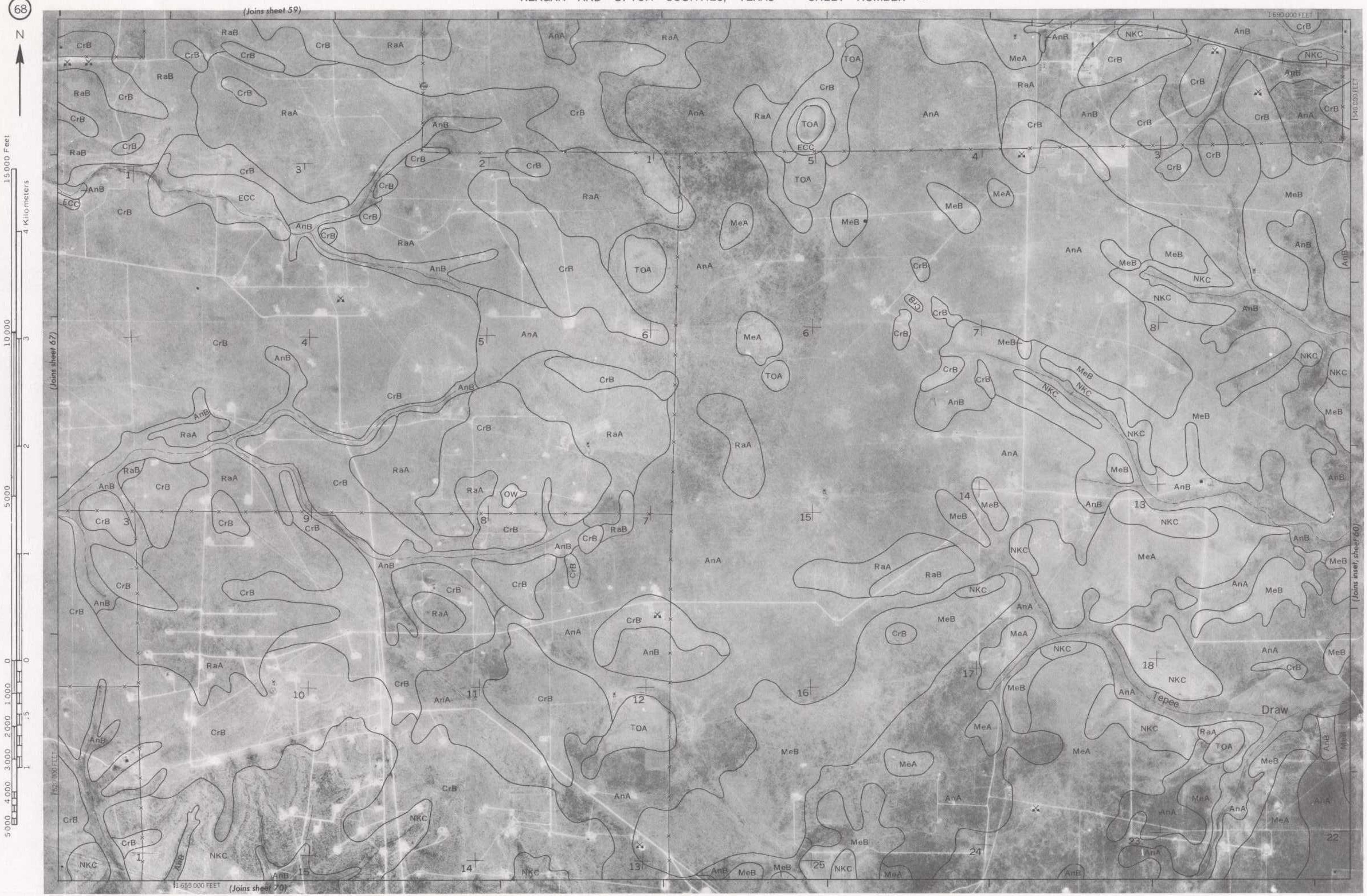

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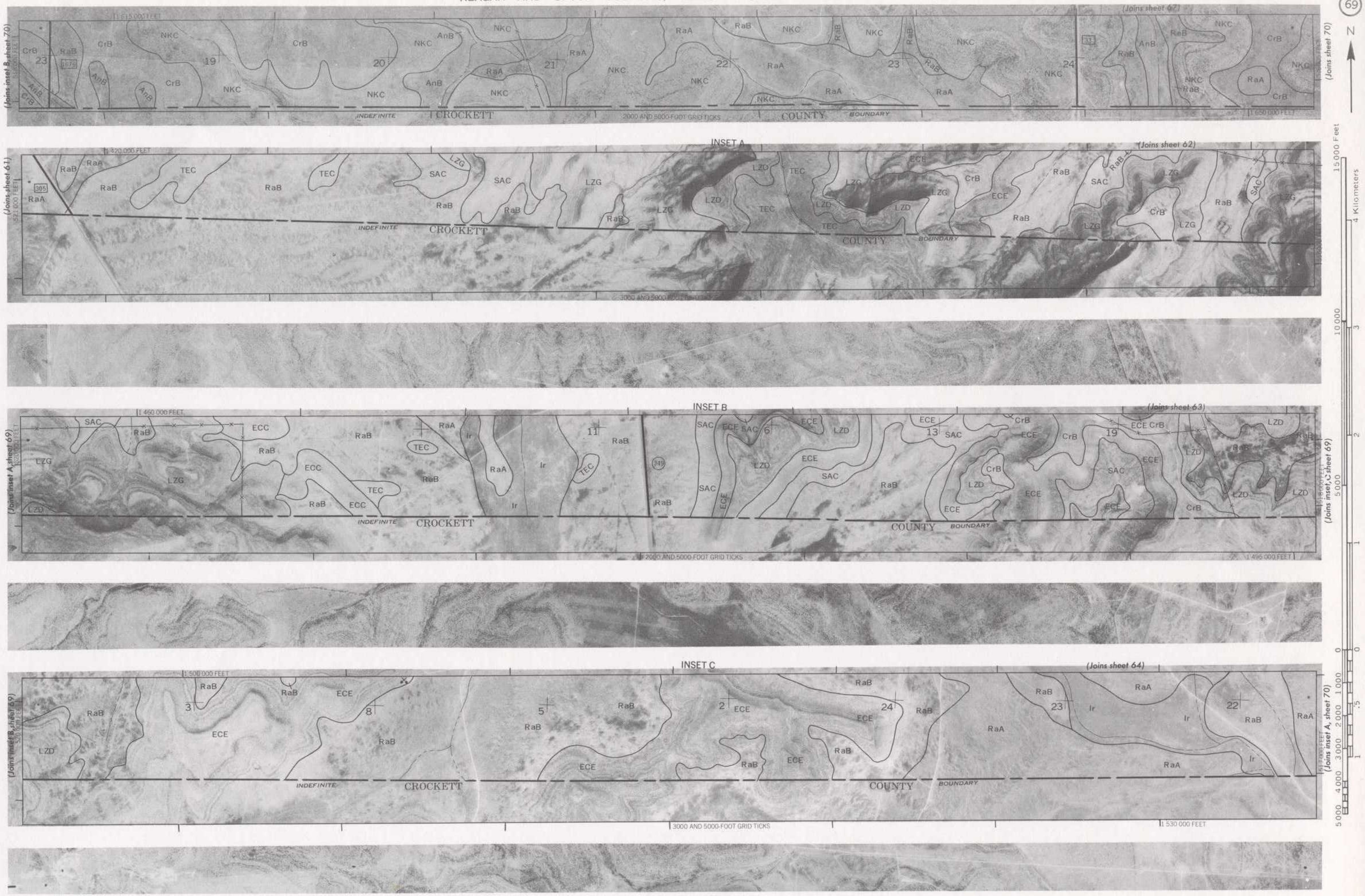

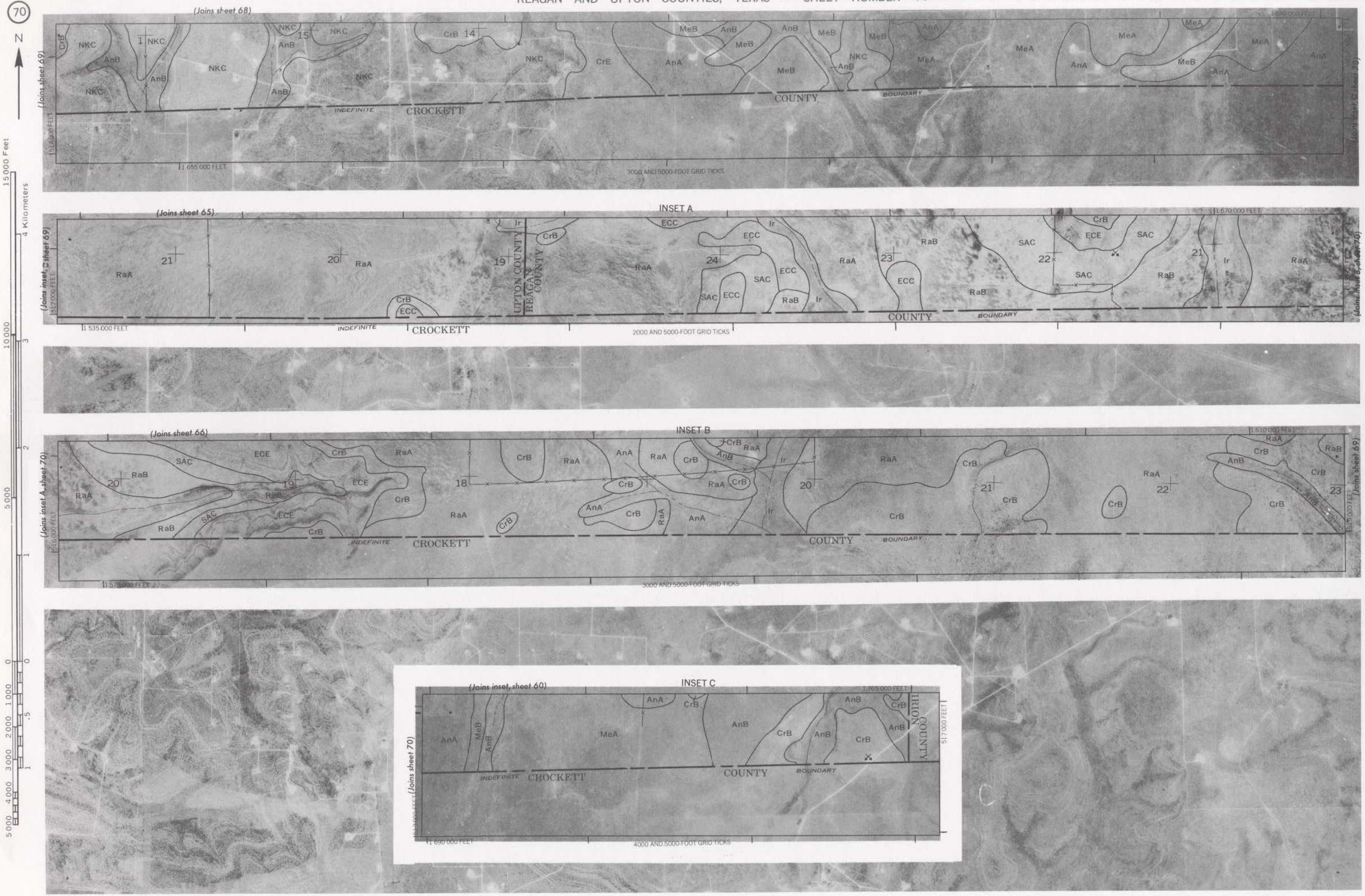

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